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Student Hanual, Student's Job Book.

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ABSTRACT'

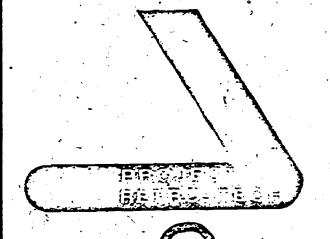
This kit contains materials for an eight hour course on home weatherization. This course is designed for: (1) work-crew supervisors; (2) secondary or post secondary vocational-technical students; and (3) adults wishing to improve their vocational-technical skills. Contained in this kit are: (1) a teacher's guide; (2) charts for an overhead projector; (3) a student manual; and (4) a home winterization job book. These materials promote the use of existing technology for home retrofitting. Lesson plans are provided in the teacher's guide. The job book is similar to an energy audit workbook. The student manual explains the how and why of winter comfort heating relative to this course. (MR)

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Federal Energy Administration Washington D.C.20461



KIT CONTAINS:

TEACHER'S GUIDE

CHARTS FOR VISUALS

STUDENT'S MARUAL

STUDENT'S JOB BOOK

JUNE 1975

TEACHER'S

KIT

for

Course on

HOME:

WINTERIZATION

PREFACE

This booklet was prepared as a guide to teachers in developing lesson plans for a Home Winterization Course which promotes the utilization of known <u>RETRO</u>fit <u>TECH</u>nology to improve thermal characteristics and conserve energy in residential housing.

Although the suggested lesson plans contained in this booklet have been designed for a special course for supervisors of work-crews actually engaged in home winterization, the concepts embodied in the individual lessons can also be incorporated into the curriculum of construction trades programs at vocational technical schools at the secondary, post-secondary or adult education levels.

This material was developed for the Federal Energy Administration (FEA) by the following individuals at the University of Maine at Orono:

Richard C. Hill, Professor, Mechanical Engineering; Charles W. Kittridge, Extension Agricultural Engineer; and Norman C. Smith, Professor Agricultural Engineering

Additional copies of the training materials used in the Home Winterization Course may be obtained, while the supply lasts, by writing to:

Federal Energy Administration Region I 150 Causeway Street Boston, Massachusetts 02114

FEA welcomes your ideas and comments about the Home Winterization Course. In addition, we would appreciate information from you regarding your use of the training materials, either for special groups or for vocational students pursuing a career in the construction trades. Your comments, along with any suggestions for improving the training materials should be mailed to the above address.

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Rogional Administrator Region I

Project Retro-Tech

TEACHER'S GUIDE ON HOME WINTERIZATION

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FORWARD

PROJECT RETRO-TECH has evolved from efforts by the Federal Energy Administration (FEA) to fill a need expressed by various consumer groups. On the one hand, community services agencies which utilize Federal and State funds to winterize the homes of fixed and low-income elderly and families have pointed to a need for a source of technical know-how to improve the effectiveness of their winterizing measures, either in terms of higher fuel savings or reduced installation cost.

On the other hand, many consumer groups have pointed to the difficulty in locating qualified technicians who specialize in winterizing homes. Firms which sell either insulation or storm windows and doors are not always properly staffed with trained specialists who can make an overall assessment of thermal deficiencies and recommend optimum corrective action. Misapplication or lack of attention to any key element in the total winterization process can negate the fuel savings and cost savings resulting from the installation of insulation and storm windows.

The shortage of skilled and trained technicians who specialize in winterizing homes will be further aggravated during the next few years as homeowners turn to retrofit measures for relief from the higher costs of energy.

The expanding requirements for a large cadre of skilled technicians who have been trained in techniques for winterizing the homes of all segments of the population will place additional burdens on the vocational-technical schools at the secondary, post-secondary and adult education levels. The Home Winterization Course developed by FEA is designed to assist the vocational-technical schools to meet this challenge.

It should be pointed out, however, that the FEA Winterization Manual is only one of a series of training material's being developed by FEA, HUD, and private industry groups. These additional training materials, when they become available, will enable the vocational-technical schools, not only to expand the content of the initial Home Winterization Course, but also to add other courses to train the cadre of specialists which will be required to fill the many new business and employment opportunities being created as a result of the increased emphasis on home winterization by all segments of the population.

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GENERAL LESSON PLAN

FOR

HOME WINTERIZATION COURSE

A. COURSE OBJECTIVES:

- 1. Given the FEA Winterization Manual and Job Book, which are based on known technology for retrofitting residential housing, the general objective of the Home Winterization Course for Work-Crew Supervisors is to train community services groups to utilize available technology when retrofitting residential housing, under government-aided winterizing programs, as an effective means for improving thermal characteristics of housing and reducing energy consumption.
- 2. Given the FEA Winterization Manual and Job Book (as well as other training materials as they are developed by FEA and others), the general objective is to enhance the vocational and avocational opportunities of youths and adults enrolled in both the accredited and non-accredited construction trades programs, by modifying the curriculum of these programs to include such courses, teaching modules and/or lesson units as may be appropriate to prepare students for the new business and employment opportunities that are being created as a result of increased emphasis on home winterization by all segments of the population.

B. INSTRUCTIONAL OBJECTIVES

- 1. ESTIMATION: Given the physical dimensions and construction features of a detached residential structure, a student will prepare for the homeowner a written analysis (Job Book), containing the following:
 - a. Identification of gross thermal deficiencies of the structure which result in heat losses by infiltration and conduction:
 - b. Comparison of current heating requirements with the potential savings;

- c. Job Write-up, from which the material specifications and bill of materials will be prepared;
- d. Bill of materials for the feasible remedies, including costs and pay-back period.
- 2. INSTALLATION: Given a job write-up (Job Book) for a detached residential structure, the student will describe and/or demonstrate to others the proper methods for installing the specified materials. In addition, the student will describe and/or demonstrate the method for conducting a post-evaluation at the end of a heating season to determine the actual energy saved by a retrofit program.

C. EQUIPMENT REQUIRED

The following equipment is required for the classroom lectures and/or demonstrations:

- 1 Projection screen
- 1 Overhead Projector
- 1 Set of Transparancies (Prepare from charts contained in supplement to this Guide)
- 1 Set 35 mm Slides Optional (may be obtained on loan from the FEA Regional Office)
- 1 Sample of common forms of insulation and other winterizing materials.

D.: STUDENT MATERIALS

- 1. FEA Home Winterization Manual
- 24. FEA Home Winterization Job Book

E. LESSONS

Lesson plans are included in this booklet on the following topics:

No.	Topic	Suggested Class Time (hr:min)
1.	Overview of Course	0:30 ~
2.	Introduction to Heat Loss	∋0:30
3.	Heat Loss By Conduction	1:00
4.	Heat Loss By Infiltration	0:30
•	Home Winterization in 4 Steps	-
5A.	Step 1 - Inspection	0:30
5B.	Step 2 - Calculation	_ 0:30
5C.	Step 3 - Evaluation	.1:00 .,
5D.	Step 4 - Installation	3:00
6.	Job Book Example by Students	<u>0:30</u>
	Total Suggested Class Time	8:00

F. INSTRUCTIONAL STRATEGIES

1. Course for Work-Crew Supervisors

In cooperation with the State Energy Office and the State Office of Economic Opportunity, technical-vocational schools are encouraged to offer this 8 to 12 hour training course to work-crew supervisors, foremen or estimators who are engaged in government-sponsored programs for winterizing the homes of fixed and low-income elderly and families.

2. Post-Secondary and/or Secondary Vocational hnical standard

For students who are pursuing a career in condential construction and/or retrofitting field, the value of the condential schools are encouraged to modify the lift unit all programs by incorporating one or more of the esson constitute into such related courses as carpentry, resulting the content of the con

3. Adult Education Program

For adults who wish to enhance their vocation avocational opportunities, the vocational-technical schools are encouraged to conduct non-credit courses in the winter encouraged upon the existing as well as not forts. Training materials being developed by FFA others.

G. FORMAT OF LESSON PLANS

The lesson plans which begin on the follow's page teache contain "Points of Emphasis" to be covered at the nasis during the classroom lecture. Adjacent to men and point is a page reference in the student's to ual force the Chart No. of the visual aid to be used rein the emphasis point.

The visual aids, either transparencies for enabled projection or 35mm slides, should be proposed locally from the set of 8" x 10-1/2" charts contained in Guide separate package which accompanies this Tell ris riste Each chart is numbered to coincide with the proposed Point of Emphasis.

If equipment is not available to you for pring 1 transparencies from the accompaning charts all verach sets of transparencies have been distributed to each State Energy Office in New England for the vocational-technical schools.

For the convenience of the Teacher when revening a Lesson Plan; each chart appears in miniature at this bottom of the appropriate page of the Teacher's Guide

	POINTS OF EMPHASIS. Manual Char Page No	
1.	Objective(s) of Course: a. Learn to use simplified techniques for utilizing known technology when retrofitting residential structures to improve thermal characteristics and reduce energy consumption.	L
3	b	

(Lesson continued on next page)

Chart C - 1

PROJECT RETRO-TECH

HOME

WINTERIZATION

COURSE

Chart C - 2

INSTRUCTIONAL OBJECTIVES

ESTIMATION

STUDENT WILL PREPARE WRITTEN ANALYSIS CONTAINING:

- (1) IDENTIFICATION OF DEFICIENCIES
- 2) COMPARISON OF REQUIREMENTS/SAVINGS
- (3) JOB SPECIFICATIONS
- (4) BILL OF MATERIALS

INSTALLATION

STUDENT WILL:

- (1) SUPERVISE APPLICATION
- (2) COMPUCT POST-EVALUATION



(Continued from previous page)

	(Continued from previous page)		· · · · · · · · · · · · · · · · · · ·
	POINTS OF EMPHASIS	Manual Page	Chart No.
2.	Instructional Objectives		
1	Estimation: Given the physical dimensions and construction features of a detached residential structure, a student will prepare for the homeowner a written analysis (Job Book), containing the following:		
	(a) Identification of gross thermal deficien- cies of the structure which result in heat losses by infiltration and conduction		
	(b) Comparison of current heating requirements with the potential savings;		
	(c) Job Write-up, from which the material specifications and bill of materials will be prepared;	•	
7	(d) Bill of materials for the feasible remedies, including costs and pay-back period.		
	Installation: Given a job write-up (Job Book) for a detached residential structure, the student will describe and/or demonstrate to others the proper methods for installing the specified materials. In addition, the student will describe and/or demonstrate the method for conducting a post-evaluation at the end of a heating season to determine the actual energy saved by a retrofit program.		
	~		
·	(Lesson continued on next page)		
<u>-</u>			

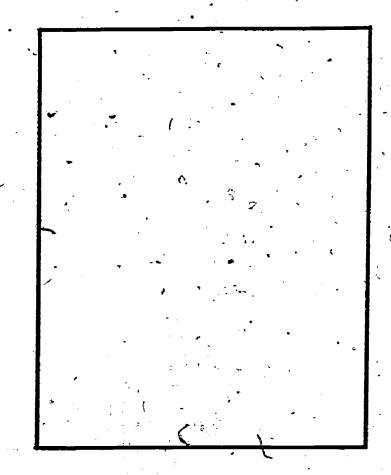
·	(Continued from previous page)	1	<u> </u>
	POINTS OF EMPHASIS	Manual Page	
3.	Course Content:		C-3
	(a) Introduction to Heat Loss		
	(b) Building Heat Loss by Conduction		•
	(c) Building Heat Loss by Infiltration	ľ	
	(d) 4 Steps to Home Winterization		
~	Optional:		1
	(e) Laboratory Exercises	Ì	,
**************************************	(f) Field Exercises		·,

Chart C - 3

HOME WINTERIZATION COURSE

* LESSONS

- A. INTRODUCTION TO '
 HEAT LOSS
- B. BUILDING HEAT LOSS
 BY CONDUCTION
- C. BUILDING HEAT LOSS
 BY INFILTRATION
- D. 4 STEPS TO HOME WINTERIZATION



	POINTS OF EMPHASIS	Manual Page	1
٦٠.	Most homes can use much less fuel with- out sacrificing comfort. Fuel can be saved by improving building.	1	C-4
.2.	It is not the "Cold" that comes in; it is the "Heat" we buy that escapes to the outside.	1	C-5

(Lesson continued on next page)

Chart C - 4

MOST HOMES

CAN USE

MUCH LESS FUEL

WITHOUT

SACRIFICING

COMFORT

Chart C - 5

IT IS NOT THE

COLD

THAT COMES IN....

IT IS THE

HEAT WE BUY

THAT ESCAPES

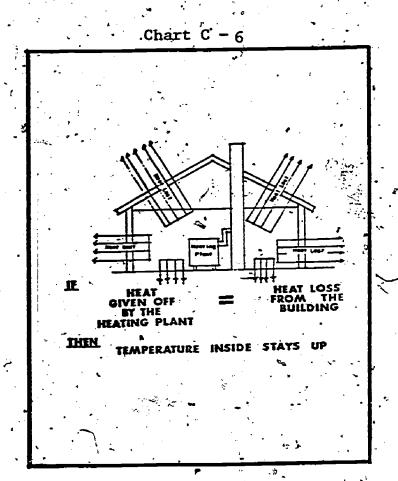
TO THE OUTSIDE

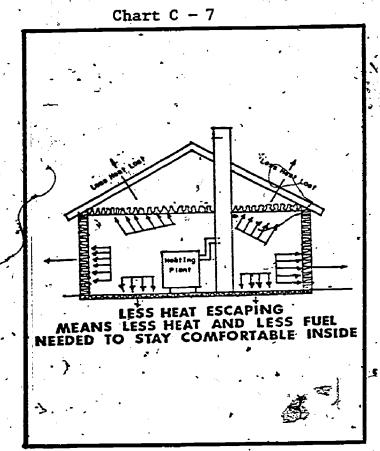
LESSON PLAN.NO. 2 INTRODUCTION TO HEAT LOSS

(Continued from previous page)

1	,			35 m
Ì	•	PO-INTS OF EMPHASIS	Manual	
	1		Page	No.
7	, 5			0
: -	de.			
	3.	, Heat which escapes must be replaced.	2	C-6 ·
	4.	When less heat escapes, less fuel is	2	C-7
J		required.		ľ
			· .	
			1	
`			1	
,				

(Lesson continued on next page)





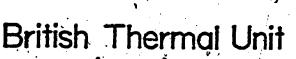
INTRODUCTION TO HEAT LOSS

(Continued from previous page)

	POINTS OF EMPHASIS	Manual Page	
5.	"BTU" as a unit of measure, is very small.	4	C-8
6.	Heating Unit concept will simplify calculations.	3	C-9
	One heating unit represents about 1000 BTUs.		\$ - \$ - \$ - \$ - \$ - \$ - \$ - \$ - \$ - \$ -

(Lesson continued on next page) .

Chart C - 8



(B.T.U)

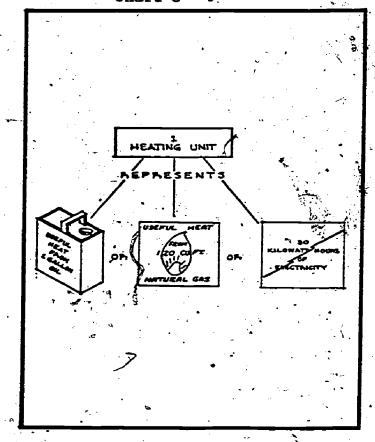
THE HEAT NEEDED TO RAISE ONE POUND OF WATER ONE DEGREE FAHRENHEIT

--- APPROXIMATELY THEMEAT GIVEN

OFF BY BURNING



· Chart C - 9



INTRODUCTION TO HEAT LOSS

(Continued from previous page)

-	POINTS OF EMPHASIS	Manual Page	
7.	Heating requirements are calculated on seasonal basis to determine total fuel use.	3 .	C-10
8.	District Heating Factor concept allows for climatic differences between areas.	3	C-11 C-12

(Lesson continued on next page)

Chart C - 10

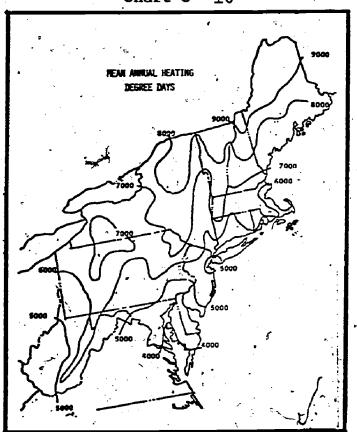


Chart C - 11

THE AREA HAS 4000 HEATING DEGREE DAYS_.

THE
DISTRICT HEATING
FACTOR
IS

INTRODUCTION TO HEAT LOSS

(Continued from previous page)

	POINTS OF EMPHASIS	Manual Page	В :
•			
9.	HOME WINTERIZATION IS A 4-STEP PROCESS:	3	C-13
	(a) STEP 1: INSPECTION OF THE BUILDING Inspect the building to determine its construction characteristics.	3	C-14
	TES CONSCIUCCIÓN CHATACTERISCICS.	- ¥	
•	(b) STEP 2: CALCULATION OF HEAT LOSSES Calculate the heat losses from the	3 🏃	11
	house		

(Lesson continued on next page)

Chart C -12

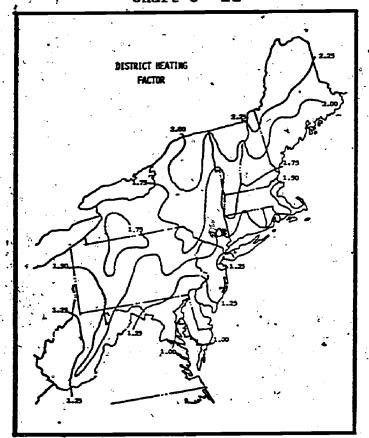


Chart C - 13

HOME WINTERIZATION IS A 4 STEP PROCESS

INTRODUCTION TO HEAT LOSS

continued from previous page

3.00	POINTS OF BILL III	Manual Page	
	(c) STEP 3: EVALUATION OF THE DATA Evaluate the building character- istics and heat losses to determine what measures should be taken.	.3	(C-14
	(d) STEP 4: INSTALLATION OF MATERIALS Install the winterizing materials.	3	n
10.	JOB BOOK has been designed for recording this information on each separate building to be winterized.		C-15
	ing to be winterized.		

(End of Lesson No. 2)

Chart C #14

4-STEP PROCESS

- 1. INSPECTION OF THE BUILDING
- 2. CALCULATION
 OF HEAT LOSSES
- 3. EVALUATION OF THE DATA
- 4. INSTALLATION OF THE MATERIALS

Chart C - 15



LESSON	PLAN	NO.	3
		110	_

			· ; ?]t
	POINTS OF EMPHASIS	Manual Page	
1.	Heat loss by Conduction means heat removed by flow through the exterior materials.	4	C-16
2.	Rate of Heat Loss depends upon: - Area of surface - Length of time - Type of material - Temperature difference - across the surface.	4 (C-17
3 .	Materials which have low rate of heat flow are thermal insulators.	4	C-17

(Lesson continued on next page)

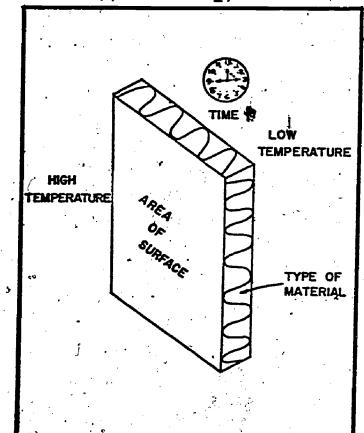
Chart, C - 16

€Chart C ~ 17

CONDUCTION

HEAT LOST
THROUGH THE

EXTERIOR SURFACES



(continued from previous page)

POINTS OF EMPHA	S I S	Manual Page	Chart No.
4. Types of insulation material of in building construction are:	commonly used	4	- :
(a) <u>Loose Fill</u> - Glass or rockwool, wood	fiber,	4	(Show Sampl
plastics - Low cost - Use on horizontal surface	es		of each)
Will settle(b) Blanket or Batt		4	(Show
- Glass or rockwool, wood	fiber	**	Samplof
- Low cost - Most common - Common thickness 3-1/2"			each)
- Common widths 16" & 24"- - Blankets comes in rolls - Batts come in shorter le		<i>y</i>	
- Both come with, or without barrier.	ut, vapor 🐇		
(c) Rigid Insulation	*	.4	(Show Sampl
- Fiber boards, foamed pla - Higher cost - Generally not used for h winterization.	(3)		of each)
	· · ·		•
5. Insulating value of material i by its Resistance, or "R" valu	e.	6	
The higher the "R" value, better the insulation.	the	•	
		. •	Ĵ
(Lesson continued on next page) ************************************		4

-	(continued from previous page)		() -
•	POINTS OF. EMPHASIS.	Manual Page	
6.	From the table of "R" values in the Manual, compare the values of some common materials found in house construction:	6	C-18,
	(a) Air Film and Spaces (b) Masonry	6	c-19 c-19
		•	•(

(Lesson continued on next page)

Chart C - 18

Chart C - 19

	THICKNESS.	'R' YALEE
Ate Frie and Season	THE LEAST	<u> </u>
Air space, bounded by ordinary materials. Air space, bounded by aluminum foll	7/4, th make 7/4, th make	0.91 2.17
Esterior surfacé resistance Jaterior surface resistance	::. ´	0.17 0.66
Braners.	} .	
Seed and gravel concrete elect Seed and gravel concrete block Listing to see concrete block	7 12 12 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	1.11 1.25 2.00
Lightwoight concrete bloch Face brick Concrete cast in place	12* 4* 8*	7.13 8.44 8.84
<u> Antidios Meterials - Conorel</u>	~*	
Head sheathing or surfloor Fiber board invaliding sheathing Figures	7/4° 1/4°	1.00 2.16 0.79
Plymod Plymod Bevel lagged siding	1/2* 2/8* 1/2* A 8*	6.63 6.47 6.81
Bivel lapped siding Tertion! Seepes and groove based Grap siding	1/4° 4 10° 3/4° 3/4°	3,05 - 3,00 0,94
Achesten beerd 1/8" gymen lath and 1/8" plester Appen Ameri	1/4" 3/4" 3/8"	8.13 / 8.42 6.32
Interior plywadd patel Bellding paper Tagar barriar	1/4° 二	0.21 0.66 0.00
Head shineton Aughots shington Stanton	= '	6.97 6.44 6.49
Carpet with fiber ped	-	3
Insulation Pateriels (pineral west, class west,		
Elamet or betts Elamet or betts Elamet or betts	3 1/2	3,70 11,00 19,00
Laces fill Bigid impolation board (sheething)	74: 1:	2.33 2.10
Eligits reduces Public victor Exterior days	= =	POS. 7.00 POS. 2.00 POS. 2.00

			•	
	• .		•	· · ·
•	äre	FILR AND SPA	CCC	
		C1101 FEET 378	<u> </u>	
	BATERIAL			
			5/4" on no	
			3/4" OR MO	
EXTERIOR SURFA	•			0.17
INTERIOR SURFAC	E RESISTANCE .	•••••••	AIL	0.68
	$(-1)^{-1} = (-1)^{-1}$			•
		i.	•	
		1		•
•		MASCRITY	•	
				·
	Material		` Tercentss	TO VALUE
SAME AND GRAVEL	CONCRETE BLOCK			1.11
Limitation con				1,28
Lienthezent con				2.00 2.13
FACE BRICK				0.44
CONCRETE CAST IS			•	0.64
			•••••	V.04
	· · · · · · · · · · · · · · · · · · ·		•	
	•		•	
-				_

7	POINTS OF EMPHASIS	Manual Page	
		,	
	(c) Building Materials - General	6	C-20
	(d) Insulation Materials	6	ر C−21
50.	(e) Windows and Doors	6	C-21

(Lesson continued on next page)

Chart C - 20

THE PROPERTY OF THE PROPERTY O			
Reteries	Iniconess 3	YACU	Ľ
MOOD SHEATHING OR SUBFLOOR	_ 3/4°	1.00	
FIRER BOARD INSULATING INCATHING	3/9"	2.10	
PLYNOOD	5/8"	0.79	
Parioco	1/2"	0.63	
PLYNIDOD	3/8"	0.47	
BEVEL LAPPED SIDEMS	1/2" x 8"	0.81	
BEVEL LAPPED SIDING	3/4" x 10"	1.05	
VERTICAL TORGUE AND GROOVE	3/4"	1.00	1
Bnor \$19186	3/4"	0.9	4
ASSESTOR BOARD	νσ· `	0.13	
3/8" STPEUR LATH AND 3/3" PLASTER	3/4"	0.42	
PIPSUR BOND	3/8"	0.又	
INTERIOR PLYHOOD PANELING	1/4"	0.31	
BUILDING PAPER		0.06	
TAPOR BARKIER	·	0.00	
Moon sources	-	0.87	
ASPRALT SKINGLES	, –	0.44	
LINGLEDI	· -	0.06	
CARPET MITH FIBER PAD	. - :	2.0	
Engwood PLOOR		0.71	-
			•
	ა .		

Chart C - 21

| THICKNETS | THICKNETS | TRICKNETS | TRICKNET OR BATTS | TRICKNET OR

VINDOVS AND DOOR

To simplify calculations, use the following approximate "R

BATTERIAL 9	VALUE
SINGLE WINDOW	1.00
BOUBLE WINDOW	2.00
Extensor Doon	2.00

LESSON PLAN NO. 3 BUILDING HEAT LOSS BY CONFIDENCE (continued from previous page)

POINTAS OF EMPHASIS

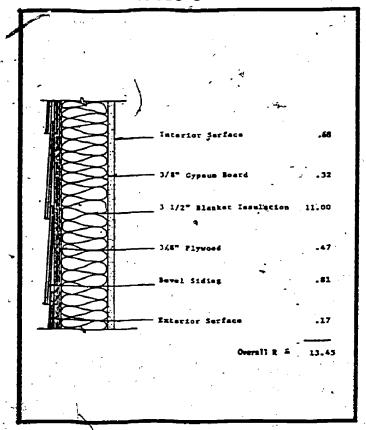
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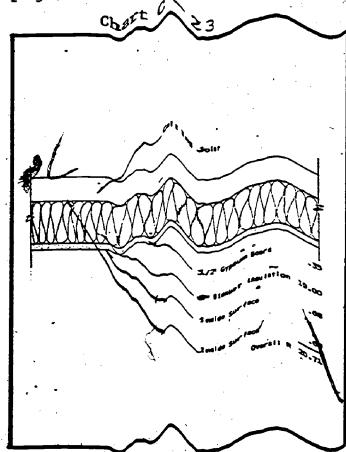
"R" values of materials can be added together to obtain an overall resistence or "R" value of a building section.

- (a) Typical overall "R" for wall section
- (b) Typical overall "R" for ceiling.

(Lesson continued on next page)

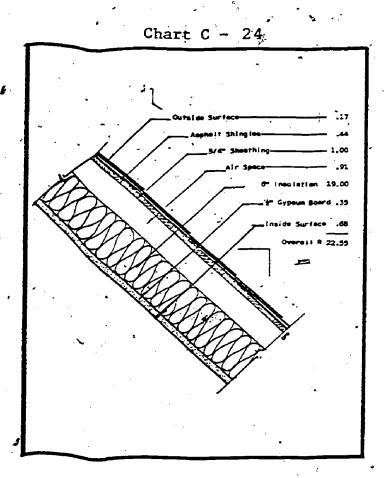
Chart C - 22

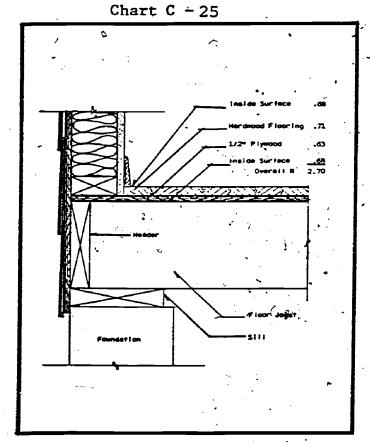




<u> </u>	(Continued from previous page)	+,	
	POINTS OF EMPHASIS	Manual Page	
	(c) Typical overall "R" for Roof.	5 .	C-24
	(d) Typical overall "R" for Floor.	-5 .	C-25
8.	Vapor Barrier: Moisture in air exerts pressure. Moisture flows from high pressure side to low pressure side.	5	C-26
	As moisture flows from inside to outside, the temperature drops. When the dew point is reached, the moisture condenses, causing wetting of insulation and framing.	•	
		•	-

· (Lesson continued on next page)





•	(Continued from previous page)	1	<u> </u>
PO	INTS OF EMPHASIS	Manual Page	
flow inst	ce vapor barrier will reduce the vof moisture before it reached the place the vapor barrier on inside (warm side).		
(a)	Poly film and aluminum foil are excellent; kraft paper is average.		
(b)	Seal with pressure joint. Remove moisture that escapes through vapor barrier by venting to the outside.	j	
	(End of Lesson No. 3)		

(Lesson No.4 starts on next page)

Chart C -26

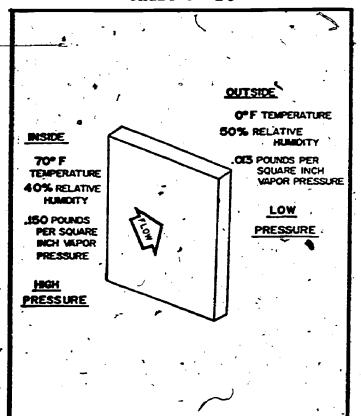


Chart C -27

INFILTRATION

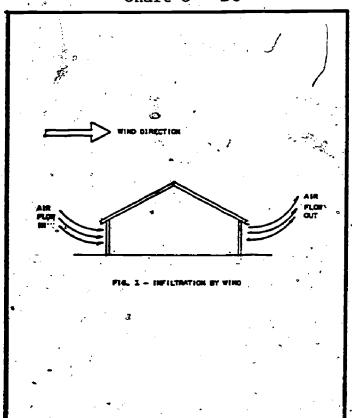
HEAT LOST BY:

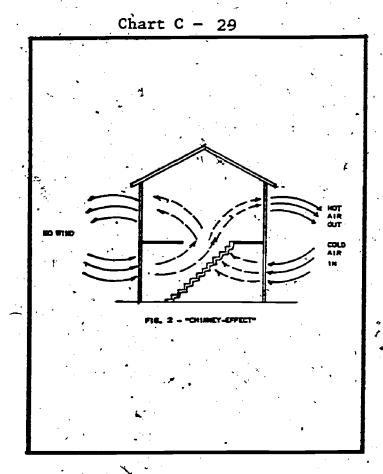
COLD AIR
COMING IN
AND
WARM AIR
GOING OUT

	POINTS OF EMPHASIS	Manual Page	
1.	Heat is lost by cold air coming in and warm air going out. This leakage or infiltration is caused by two factors:	7	C-27
-	(a) Infiltration by Wind occurs when wind flows in on one side and warm air flows out on the leeward side.	7	C-28
	(b) Infiltration by "Chimney Effect" occurs when inside air is warmer than outside air. The building acts like a chimney: heated air which tends to rise leaks out of cracks, and is replaced by cold air which is sucked in at lower levels.	7	C-29

(Lesson continued on next page)

Chart C - 28





BUILDING HEAT LOSS BY INFILTRATION

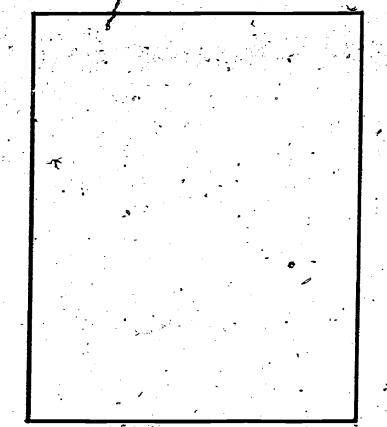
(Continued from previous page)

	POINTS OF EMPHASIS	Manual Page	
			•
2.	Each cubic ft. of air that must be heated requires 0.02 BTU for every one degree F increase.	7	-
3.	Infiltration Check List describes the typical conditions which result in infiltration rates of one, two and / three air changes per hour.	10	C∸30
	End of Lesson No. 4	1	

(Lesson No. 5A starts on next page)

Chart C - 30

			٠	•		
			. •	•		
	1		•		-	
		- -		-	,	
BUTLDING EQUIPMENT	ONE Air Change For Neur	0	TVO . Air Change Per Hour	②	THREE Air Change Per Hour	<u>③</u>
CELLM	Tight, so crecks,		Same foundation gracks, so weather		Store foundation,	,
	social action pladeus, as grees astrone lasts	- 1	stripping on cellar pindous, orade ontroces	-	locange oras, poor sost cround group patroca	
CRAM.	(ol	met tiget	O	Sairt floor, loose	\bigcirc
SPACE	Plymos floor, no trop door leaks, so leaks around		Tauque and groups board floor, ressensité fit en		fit around olyes,	
	electricat .		pipes, acc.			
WIRBONS	Steen water i	ा	to stare stateur.	\overline{O}	de séare minésas. Tosse fit an	\bigcirc
280Ek	Sand File on	⇉	Legal Start Cors.	$\stackrel{\sim}{\sim}$	He stern doors	imes
	**** **** . (의	poor fit on invide from	띡	Toote fit be	<u> </u>
WALLS	Coulded windows	_ 1	Coulting to poor repair, building	\neg	Se indication of building separ,	
	Smilding paper (기	and heret (\cup	erident craces around deer and alorse fages	
•	•		-	• .		*
				"	-	



LESSON PLAN NO. 5A HOME WINTERIZATION IN 4 STEPS

STEP 1 - INSPECTION

	Page	Chart No.
	2	•
1. (Refresher from Introduction Section) HOME WINTERIZATION IS A 4 STEP_PROCESS:	3 `.	
(a) STEP 1 - INSPECT the building to determine its construction characteristics	•	
(b) STEP 2 - CALCULATE the heat losses from the building.		
(c) STEP 3 - EVALUATE the building characteristics and heat losses	•	
to determine what measures should be taken.		
(d) STEP 4 - INSTALL the winterizing materials.		
JOB BOOK is designed to enable a Work- Crew Supervisor (or Job Estimator) to follow this 4-step process in a systematic manner.	,	م د شده سد .
Perhaps, the best way to become familiar with the JOB BOOK is to simulate the process by working out an example of a building to be winterized.		
The charts that you will see have been marked up to show the information that an Estimator will obtain when he inspects the building to determine the construction characteristics.		•
	v	
(Lesson continued on next page)	, į	

	(continued from previous page)		`
e e	POINTS O'F EMPHASIS	Manual Page	
3.	STEP 1 - INSPECT the building to determine the contruction characteristics.	9	C-31
	(a) Visual inspection of building should consist of the 10 steps listed on chart.	9	C-32
ĺ	(TEACHER OPTION FOR EMPHASIS POINT NO. 3(a)	\(\frac{1}{2}\)	
,	Show 35mm color slides. See page 28.		•
``	Slides are available on loan basis.		

(Lesson continued on next page)

Chart C -31

Chart C - 32

4-STEP PROCESS

1. INSPECTION OF THE BUILDING

TO STEPS IN BUILDING INSPECTION

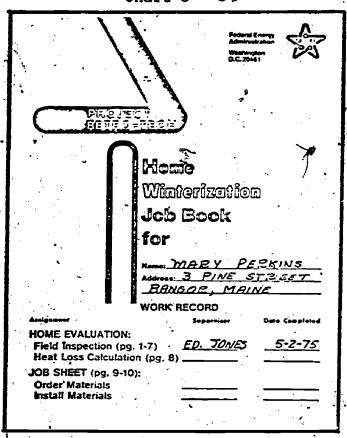
- 1. Take overall mulding dimensions Clemen, Mistin, Suddall Height)
- 2. HEASURE WINDOWS CHEESET, MIDTH)
- 3. PERSONE DOORS (HETERY, MISTIN)
- 4. Queck condition of extenion

 Clock for chacks, lack of paint, canadisms
- 5. CHECK WILL COMSTRUCTION
- 6. ORCE CELLING, BOOF
- 7. DECK PLOOR CONSTRUCTION
- 8. IMPECT POSSORTION FOR CLACKS
- S. QUECK FOR IMPLITRATION, FEEL FOR BRAFTS, OPEN ONTSIDE BOOK OMICKLY CRESISTANCE MEANS A TIGHT PIT)
- M. TALK TO THE OCCUPANT

(Continued from previous page)

	(Continued from previous page)	<u> </u>	
	POINTS OF EMPHASIS	Manual Page	Chart No.
	(b) Fill in the JOB BOOK:	و	•
	During the inspection, fill in the		.*
	. sections\of JOB'BOOK marked "Fill	•	
1	In At The Site". (NOTE: The student will be able		٠.
.'	to follow the Teacher's instructions	-	*
	by referring to the example which		•
	follows page 12 on the Home Winter- ization Manual).		
	TZacion Manualy.		
	(1) Cover: Name and Address	9	C-33
·	(2) Page 1: Description of	- 1	
	Building.	. 9	C-34
· .			2 25
	(3) Page 1A: Dwelling & Heating Information	9	C-35
4	(4) Page 2: Infiltration Table	9	C-36
	(5) Page 3: Table of Floor		Í
*	Materials"	9	C-37
-	(6) Page 4: Table of Ceiling/		
	Roof Materials	9	C-38
	(7) Page 7: Table of Wall Materials	9.	C-39
	(8) Page 9: Directions to/House		
	Location	10	C-40
		•	
		;	•
•			7
)			,
	End of Lesson 5A		

(Lesson No. 5B starts on Page 29)



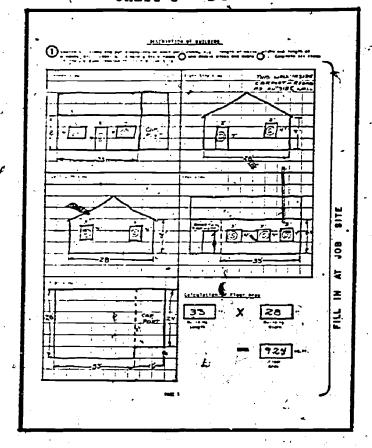


Chart C - 35

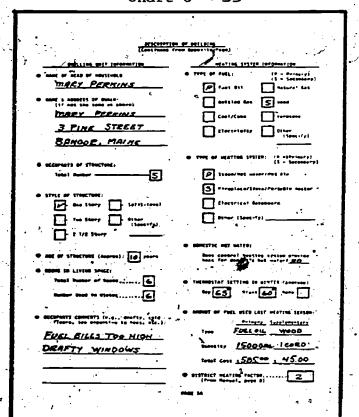
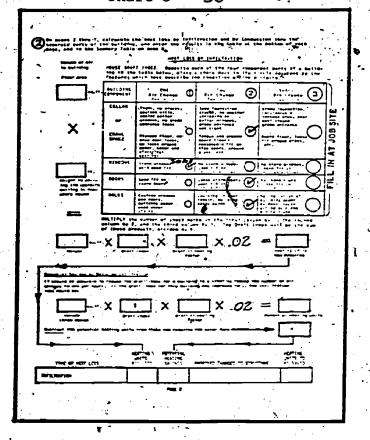
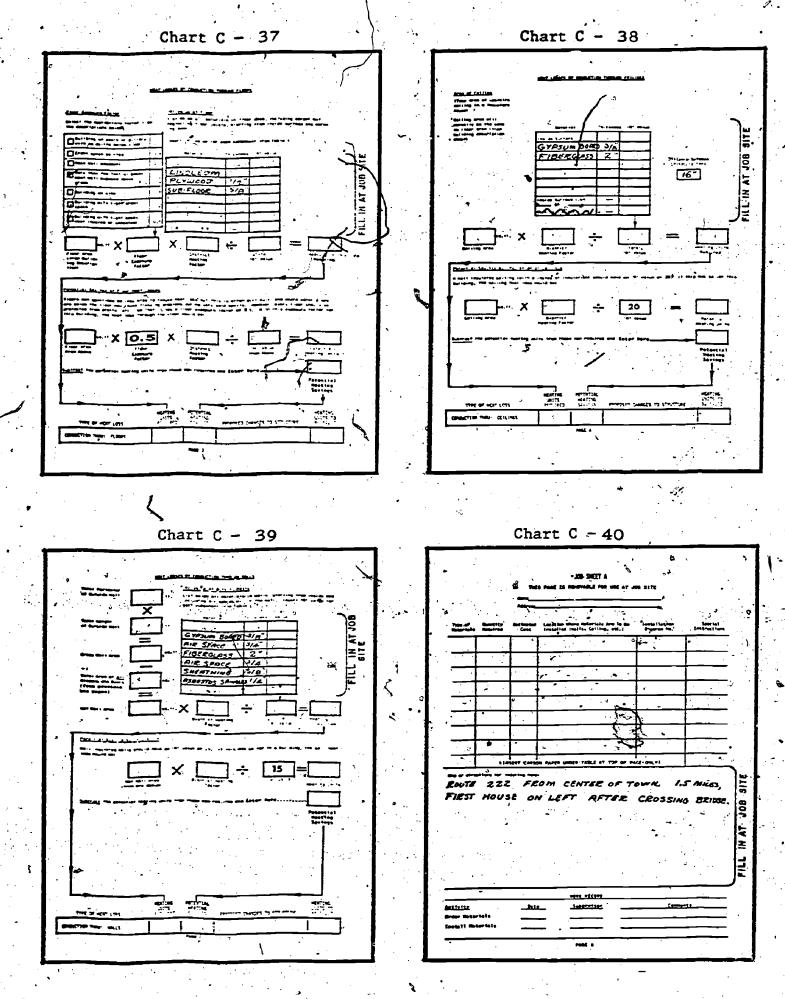


Chart C - 36





(Optional - See page 24)

	POINTS OF EMPHASIS	Manual	Chart]
		Page	No.	
	TEACHER OPTION FOR EMPHASIS POINT NO.3(a)		-4	
	(NOTE: In place of Chart C-32, the following 35mm color slides may be used to give the students a visual impression of the construction		• !	
	features of the building in the example to be worked out by the class. If these slides are not available from the State Department of Education, they may be obtained on a loan basis from the Regional Office of the Federal Energy Administration).	ī	•	
3.	(a) Visual inspection of building:		,	-
	(1) Front view		s-1	
	(2) Right side view (showing carport)		S-2	
	(3) Rear view (4) Left Side View (5) Take overall dimensions		S-3 S-4 S-5	
	(6) Measure windows		s-6	
	· (7) Measuré Doors		s-7	
	(8) Speak to occupant		S-8	
	(9) Check condition of exterior (10) Check/wall construction	۵	s-9 s-10	
	(11) Check ceilings, roof, floors		S-10 S-11	
	(12) Inspect foundation		S-12	
	(13) Look for cracks and crevices		s-13	
	(14) Check for infiltration (TURN OFF SLIDE PROJECTOR)	(END	S-14 F SLI	DES

(Emphasis Point No.3(b) is back on page 25)

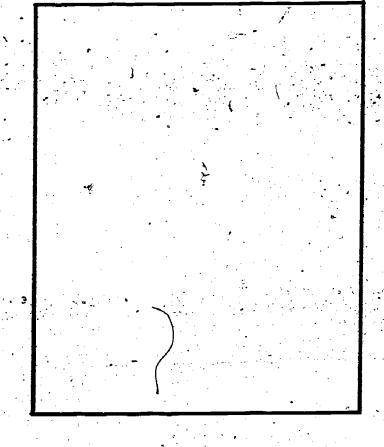
LESSON'PLAN NO.5B HOME WINTERIZATION IN 4 STEPS STEP 2 - CALCULATION

	•	POINTS OF EMPHASIS	Manual Page	
1.	O <u>t</u>	STEP 2 - CALCULATE the heat losses expected during a complete heating season: (These simple calculations do not have to be done at the job site).	,11	C-41
	7	(NOTE: The JOB BOOK pages shown on charts C-41 thru C-51 are to be completed during class time by teacher and students. Copies of the completed charts are included in this Guide and in the Manual).	•	•
		(Lesson continued on next page).		

Chart C -41

4-STEP PROCESS

- 1. INSPECTION OF THE BUILDING
- 2. CALCULATION OF HEAT LOSSES



TEP 2 - ATION

(Continued From previous page)

POINTS OF EMPHASI3S	Manual Page	Chart No.
(a) JOB BOOK Page 2: Heat Losses by Infiltration		C-42
(1) Enter Floor Area and Ceiling Height from page 1. Calculate volume of building.	•	
(2) Estimate the Draft Index based on the check marks in table.		
(1 air change) x (1) (2 air changes) x (3) 7 ÷ 4 = 1.75		
Round to 1.8 • (3) Enter District Heating Factor from page 1A.		
(4). Multiply these factors by 0.02 BTU/Cu.Ft./1°F to determine Required Heating Units.		
(5) In a similar manner, determine Potential Heating Units based on Draft Index =1.		•
(6) Subtract to determine Potential Heating Savings, and enter on bottom line.		
(Lesson continued on page 32)		

Nan		e on page 8. <u>←HEAT LOS</u>	S BY INFILTRATION	
Valume of Air in building Floor Area	HOUSE DRAI	e table below, place	each of the four compo a check mark in the o the condition of the a	onent parts of a build- circle adjacent to the building.
924	BUILDING COMPONENT	ONE Air Change Per Hour	TWO Air Change Per Hour	THREE Air Change Per Hour
	CELLAR	Tight, no cracks, caulked sills, sealed cellar windows, no grade entrance leaks	Some foundation cracks, no weather stripping on cellar windows, grade entrance	Stone foundation, considerable leakage area, poor seal around grade entrance
X	CRAWL SPACE	Plywood floor, no trap door leaks, no leaks around water, sewer and electrical openings	Tongue and groove board floor, reasonable fit on trap doors, around pipes, etc.	Board floor, loose fit around pipes, etc.
8	WINDOWS	Storm windows with good fit	No storm windows, good fit on regular windows	No storm windows, loose fit on regular windows
Height to cei ing (to upsta ceiling in two	irs	Good fit on storm doors	Loose storm doors, poor fit on inside door	No starm doors loose fit on inside door
story house)	WALLS	Caulked windows and doors, building paper used under siding	Caulking in poor repair, building needs paint	No indication of building paper, evident cracks around door and
		Sidind		
	column by 2	e number of check ma	arks in the first column, by 3. The Draft I	window frame
7392 volume	of these pr	e number of check ma and the third coll oducts divided by 4	ımn by 3. The Draft I	window frame
Potential Savings by It should be possible changes to one per t	of these pr u.ft. X Draft Reducing Infilt te to reduce the	e number of check may and the third college oducts divided by 4 lindex District Faction draft index for a building	I Heating	mindow frame mn_by 1, the second ndex will be the sum = 532 Heating Units Now Required he number of air
Potential Savings by	of these property of these property of these property of the property of the drawn	e number of check may and the third column oducts divided by 4	the Braft I Local Action Local Act	mindow frame mn_by 1, the second ndex will be the sum = 532 yearing Units Now Required he number of air infiltration = 296
Potential Savings by It should be possible changes to one per a loss would be: 7392 cu. Volume (from above)	column by 2 of these pr u.ft. X	e number of check ma, and the third college oducts divided by 4 lindex District Factorial after index for a building after index for this building	theating to 1 (that is reduce thing was improved to 1, the latting sector.	mindow frame mn_by 1, the second ndex will be the sum = 532 Heating Units Now Required he number of air
Potential Savings by It should be possible changes to one per a loss would be: 7392 cu. Volume (from above)	column by 2 of these property of these property of these property of the drawn of t	e number of check mand the third college oducts divided by 4 lindex Index District Factor Aration District Factor Distri	theating to 1 (that is reduce thing was improved to 1, the latting sector.	mindow frame Imm. by 1; the second index. will be the sum = 532 Heating Units Now Required he number of air infiltration = 296 Potential Heating Units HEATING UNITS TO

LESSON PLAN NO. 5B STEP No. 2 - CALCULATION

(Continued from page 30)

P 0	INTS OF EMPHASIS	Manual Page	Chart No.
(b)	JOB BOOK Page 3: Heat Losses by Conduction Through Floors		C-43
	(1) Enter Floor Area from page 1		<i>:</i> .
	(2) Select appropriate Floor Exposure Factor	\$	
	(3) From Table 1 on page 12, obtain the "R" value for each		***************************************
	material in the floor. Add these "R" values to obtain composite "R" value for floor. Round off value to nearest tenth of unit.		·
	(4) Enter District Heating Factor from page 1A		
	(5) Use these factors to determine the Required Heating Units and enter on bottom line.		
	(6) In a similar manner determine Potential Heating Units based on Floor Exposure Factor = 0.5.	**}	
5,	(7) Subtract to determine Potential Heating Savings, and enter on bottom line.		
			د
	(Lesson continued on page 34)		

HEAT	LOSSES BY CONDUCTION T	HROUGH FLOORS	•
	• .	•	
Floor Exposure Factor	'R' Value of Floor		
Select the appropriate factor from	List below all mater	lais in floor deck, inclu	
the descriptions below:	ing down.	sts, starting from inside	'surface and work-
Building on posts or pillars	Insert 'R' value for	each component from Tabl	• .l
with no skirts below floor 1.			_
Crawl space skirted	-	Thickness "R' Value	1
Rock Well besement 0.	Tiller to Sur toco	.68	
ment well exposed above	PLYWOOD	1/2" .65	
grade 0.	SUB-Frank	5/8" 1.00	
Building on sleb 0.	1000		
Building with tight crawl o.	5		:
Building with tight base- ment (heated or unheated) 0.3			
ment (heated or unheated) 0.	Interior Surface	.68	}
924 m.m. X 0.8	X 2	÷ 3./	= 477
Floor Area Floor (from Build— Exposure	District Heating	Total	Heating Units Required
	Freedom	•	
tion) Factor	Factor		
	ractor		
tion	***		
Potential Savings on Floor Heat Losse		s is often difficult. and	where water a pes
Potential Savings on Floor Heat Losses Floors can sometimes be insulated to rare below the floor may cause freezing	educe heat loss but this problems during very c	old spelig. However, eve	ry floor should be
Potential Savings on Floor Heat Losses Floors can sometimes be insulated to r	educe heat loss but this problems during very contains a floor exposure	old spelig. However, eve	ry floor should be
Potential Savings on Floor Heat Losses Floors can sometimes be insulated to a re below the floor may cause freezing protected from drafts, etc., so that	educe heat loss but this problems during very contains a floor exposure	old spelig. However, eve	ry floor should be
Potential Savings on Floor Heat Losses Floors can sometimes be insulated to rare below the floor may cause freezing protected from drafts, etc., so that this building, the heat loss through	educe heat loss but this problems during very contains a floor exposure	old spelig. However, eve	ry floor should be
Potential Savings on Floor Heat Losses Floors can sometimes be insulated to rare below the floor may cause freezing protected from drafts, etc., so that this building, the heat loss through	reduce heat loss but this problems during very of thas a floor exposure he floor would be:	old spelig. However, eve	ry floor should be
Potential Savings on Floor Heat Losses Floors can sometimes be insulated to rare below the floor may cause freezing protected from drafts, etc., so that this building, the heat loss through the floor Area Floor Exposure	reduce heat loss but this problems during very continuous afloor exposure the floor would be: X District Heating	factor of 0.5. With this	exposure factor for
Potential Savings on Floor Heat Losses Floors can sometimes be insulated to rare below the floor may cause freezing protected from drafts, etc., so that this building, the heat loss through the floor Area From Above Floor Exposure Factor	reduce heat loss but this problems during very continuous afloor exposure the floor would be: X District Heating Factor	R' Value from Above	exposure factor for. 299 Potential
Potential Savings on Floor Heat Losses Floors can sometimes be insulated to rare below the floor may cause freezing protected from drafts, etc., so that this building, the heat loss through the floor Area Floor Exposure	reduce heat loss but this problems during very continuous afloor exposure the floor would be: X District Heating Factor	R' Value from Above	= 299 Potential Heating Units
Potential Savings on Floor Heat Losses Floors can sometimes be insulated to rare below the floor may cause freezing protected from drafts, etc., so that this building, the heat loss through the floor Area From Above Floor Exposure Factor	reduce heat loss but this problems during very continuous afloor exposure the floor would be: X District Heating Factor	R' Value from Above	Potential Heating Units Potential Heating
Potential Savings on Floor Heat Losses Floors can sometimes be insulated to rare below the floor may cause freezing protected from drafts, etc., so that this building, the heat loss through the floor Area From Above Floor Exposure Factor	reduce heat loss but this problems during very continuous afloor exposure the floor would be: X District Heating Factor	R' Value from Above	Potential Heating Units Potential
Potential Savings on Floor Heat Losses Floors can sometimes be insulated to rare below the floor may cause freezing protected from drafts, etc., so that this building, the heat loss through the floor Area From Above Floor Exposure Factor	reduce heat loss but this problems during very continuous afloor exposure the floor would be: X District Heating Factor	R' Value from Above	Potential Heating Units Potential Heating
Potential Savings on Floor Heat Losses Floors can sometimes be insulated to rare below the floor may cause freezing protected from drafts, etc., so that this building, the heat loss through this building, the heat loss through floor From Above Floor Area From Above Subtract the potential heating units for the poten	reduce heat loss but this problems during very of has a floor exposure he floor would be: X District Heating Factor rom those now required	R' Value from Above	Potential Heating Units Potential Heating Savings HEATING
Potential Savings on Floor Heat Losses Floors can sometimes be insulated to are below the floor may cause freezing protected from drafts, etc., so that this building, the heat loss through the floor Area Floor Area From Above Subtract the potential heating units for the floor freeze from the potential heating units for the floor floo	reduce heat loss but this problems during very of has a floor exposure he floor would be: X District Heating Factor rom those now required	R' Value from Above	Potential Heating Units Potential Heating Savings HEATING UNITS TO
Potential Savings on Floor Heat Losses Floors can sometimes be insulated to rare below the floor may cause freezing protected from drafts, etc., so that this building, the heat loss through this building, the heat loss through from Above Floor Area Floor Exposure Factor Subtract the potential heating units for the	educe heat loss but this problems during very of that a floor exposure he floor would be: X	R' Value from Above	Potential Heating Units Potential Heating Savings HEATING UNITS TO

LESSON PLAN NO. 5B - STEP NO. 2 CALCULATION

(Continued from page 32)

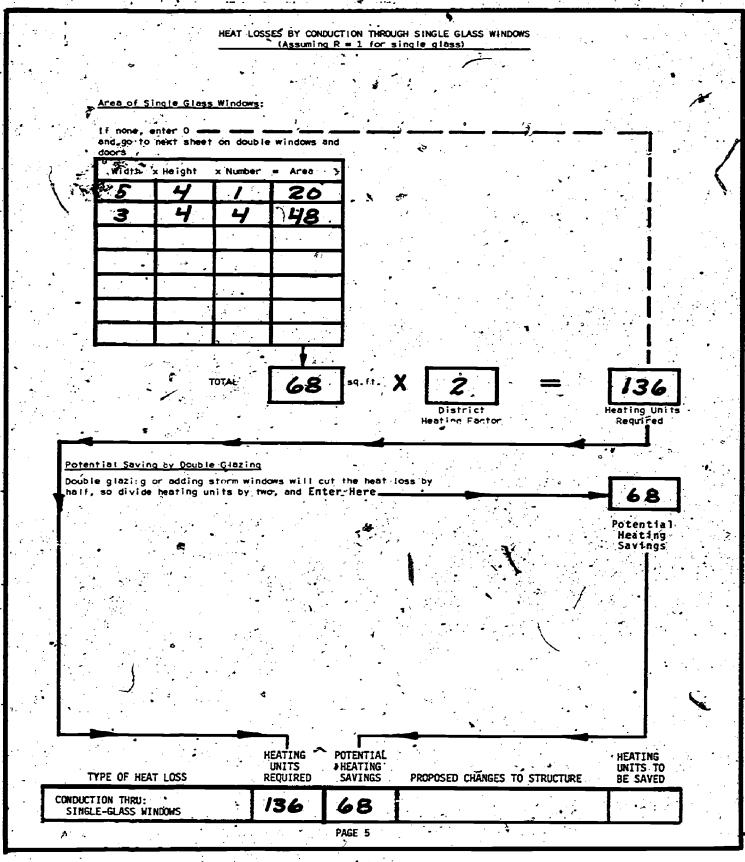
POINTS OF, EMPHASIS	Manual Page	Chart No.
	ų, į	
(c) JOB BOOK Page 4: Heat Losses by Conduction Through Ceilings		C-44
(1) Insert Ceiling Area (normally same as Floor Area on page 1).		
(2) From Table 1 on page 12 of JOB BOOK; obtain "R" value		
for each material in the ceiling (or roof, where appropriate). Add these "R"		
values to obtain composite "R" value for ceiling (or roof). Round off value to nearest		
tenth of unit.	·	
(3) Enter District Heating Factor from page 1A.		
(4) Use these factors to determine the Required Heating Units and enter on bottom line.		
(5) In a similar manner, determine Potential Heating Units based upon an "R" value of well-		
insulated ceiling equal to 20.		
(6) Subtract to determine Potential Heating Savings, and enter on bottom line.		•
		<u>.</u>
	<u>.</u> '	
(Lesson continued on page 36)	· .	•

		HEAT LOSSES BY CONDUCT!		ar verter			
	Area of Celling	\$				•	•
	Take area of upstairs:	•					
	ceiling in a two-story			•	•		
		*			• • •	•	,
	Ceiling area will normally be the same	•			•	•	1
•	as floor area (from . :	. Material.	Thicknes	s' 'R' Valuè		,	1
•	building description sheet)	Inside Surface		.68	· ~	$\Lambda_{ \Phi } = - \frac{1}{2} \left(\frac{1}{2} \right)^{-1}$	ļ
		GYPSUM BOARD	3/0"	.32	•		- 1
•	•	FIBERGLASS	24	7.40		* ·	•
	•	PIDERVIEW	-	 	Distance	. between	- 1
			┞──┤		~	rafters:	
					16	, " .	
•		,			1 Tag		
						•	
		Inside Surface (.68)		.68	•		1
		OR	-		•	•	
		Outside Surface (.17)	نحبا		•	$(x_1, x_2, x_3, x_4, x_4, x_5, x_5, x_5, x_5, x_5, x_5, x_5, x_5$)
	• • •				•	• •	_
_		7	ľ	4		F	-
	924 sq.ft. X	2 ÷		9-1	, =	203	
	Ceiling Area		- E		1		٠.
	PALLING VLAD	District		Total	= •	Heating Units *	•
	Serving Area	District Heating Factor	•	Total	•	Heating Units *	•
ſ		Heating Factor			•		
ſ	Potential Savings by Insulation	Heating Factor					
[Potential Savings by Insulation A well insulated calling (with 6	of Ceilings 5 inches of insulation) st	nould have	'R' Value	e of 20, if th	Required	
	Potential Savings by Insulation	of Ceilings 5 inches of insulation) st	nould have	'R' Value	e of 20, if th	Required	
	Potential Savings by Insulation A well insulated calling (with 6	of Ceilings 5 inches of insulation) st	nould have	'R' Value	e of 20. If th	Required	
	Potential Savings by Insulation A well insulated ceiling (with 6 building, the ceiling heat loss	of Ceilings 5 inches of insulation) st	nould have	R. Value	e of 20. If th	Required	
	Potential Savings by Insulation A well insulated calling (with 6	of Ceilings 5 inches of insulation) st	hould have	'R' Value	e of 20, 1f th	Required	
	Potential Savings by Insulation A well insulated ceiling (with 6 building, the ceiling heat loss 924 sq.ft. X Ceiling Area	of Ceilings 5 inches of insulation) st would be: 2 District	hould have	R. Value	e of 20. If th	Required of the season of the	
	Potential Savings by Insulation A well insulated ceiling (with 6 building, the ceiling heat loss 924 sq.ft. X Ceiling Area	of Ceilings Sinches of insulation) st would be:	hould have	e an 'R' valu	e of 20. If th	Required	
	Potential Savings by Insulation A well insulated ceiling (with 6 building, the ceiling heat loss 924 sq.ft. X Ceiling Area	of Ceilings Sinches of insulations st would be: District Heating Factor	<u>•</u>	e an 'R' value	e of 20, If th	Potential Heating Units	
	Potential Savings by Insulation A well insulated ceiling (with 6 building, the ceiling heat loss 924 sq.ft. X Ceiling Area	of Ceilings Sinches of insulations st would be: District Heating Factor	<u>•</u>	e an 'R' value	e of 20. If th	Required the season of the sea	
	Potential Savings by Insulation A well insulated ceiling (with 6 building, the ceiling heat loss 924 sq.ft. X Ceiling Area	of Ceilings Sinches of insulations st would be: District Heating Factor	<u>•</u>	e an 'R' value	e of 20. If th	Potential Heating Units	
	Potential Savings by Insulation A well insulated ceiling (with 6 building, the ceiling heat loss 924 sq.ft. X Ceiling Area	of Ceilings Sinches of insulations st would be: District Heating Factor	<u>•</u>	e an 'R' value	e of 20, If th	Potential Heating Potential Heating	
	Potential Savings by Insulation A well insulated ceiling (with 6 building, the ceiling heat loss 924 sq.ft. X Ceiling Area	of Ceilings Sinches of insulations st would be: District Heating Factor	<u>•</u>	e an 'R' value	e of 20. If th	Potential Potential	
	Potential Savings by Insulation A well insulated ceiling (with 6 building, the ceiling heat loss 924 sq.ft. X Ceiling Area	of Ceilings Sinches of insulations st would be: District Heating Factor	<u>•</u>	e an 'R' value	e of 20. If th	Potential Heating Potential Heating	
	Potential Savings by Insulation A well insulated ceiling (with 6 building, the ceiling heat loss 924 sq.ft. X Ceiling Area	of Ceilings Sinches of insulations st would be: District Heating Factor	<u>•</u>	e an 'R' value	e of 20. If th	Potential Heating Potential Heating	
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STEP 20.2 - CALCULATION

(Continued from page 34)

	POINTS OF EMPHASIS,		<i>C</i> 1
	PUINIS OF EMPHASIS	Manual	V .
1 7		Page	No:
			•
1 '		1	
ě			٠, ٠,
	(d) 'JOB BOOK Page 5: Conduction Through		C-45
	Single-Glass Windows		
	(1) Use sketches on page 1 to fill	1. 1	
1 .	• in table to determine Total	1	
1	Area of Single-Glass Windows.		
		<i>"</i> • , •	
8	(2) Enter District Heating Factor		
	from page 1.		
	(3) Use these factors to determine		· ·
	the Required Heating Units		
4	(based upon $R = 1$), and enter		
,	on bottom line.		
	(4) Determine the Potential		
	Heating Savings as instructed,		
	and enter on bottom line.		ľ
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	(Toggen		1
	(Lesson continued on page 38)		- [
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(Continued from page 36)

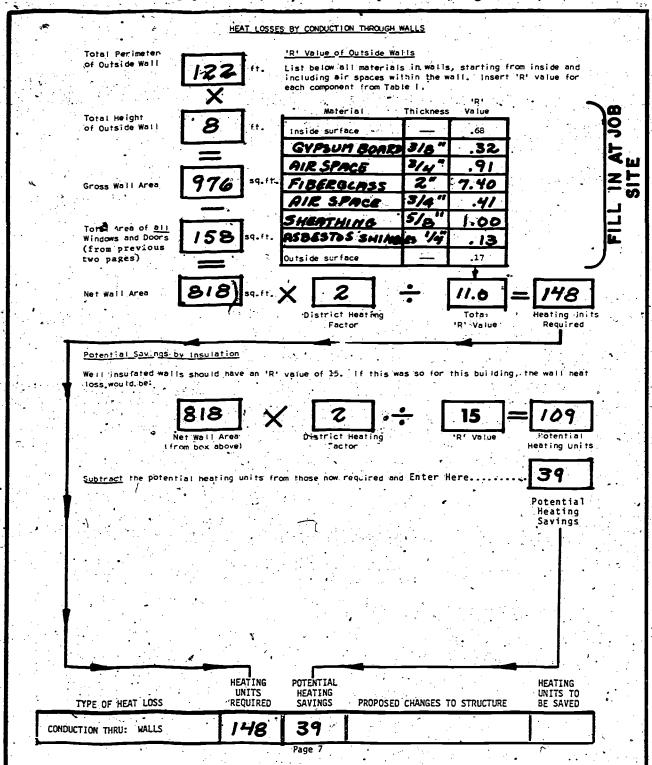
P O	INTS OF EMPHASIS	Manual Page	Chart No.
(e)	JOB 300K Page 6: Heat Losses by Conduction Through Double-Glass or Plastic Covered Windows and		C-46
	Through Doors	•	
	(1) Use sketches on page 1 to fill in table to determine Total Area of Outside Doors and Double-Glass Windows.		
	(2) Enter District Heating Factor from page 1.		
	(3) Use these factors to determine		
	Required Heating Units based upon R = 2, and enter on bottom line.		
	(4) Potential Heating Savings will be "0" unless you triple glaze. Enter appropriate figure on		
	bottom line.		
			<i>f</i>
	(Lesson continued on page 40)		

PLASTIC COVERED WINDOWS AD THEOUGH DOORS (Assuming R = 2 for these units) Area of Double Gleas and Doors Width x Height x Number Area 3 7 2 42 6 7 / 2 42 6		MET LOCATE ME COMMIN		
Area of Double Glass and Doors Width x Height x Number Area 3 7 2 42 6 7 / 24 3 4 2 2.4 District Rr. Value Heating Units Required		· · · · · · · · · · · · · · · · · · ·	•	
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DOUBLE-GLASS WINDOWS 70 , O	TYPE OF WEAT 1 OCC.	UNITS	CAUTUCE DOODOCES SHAUCES TO STREET	TIME: SE CAUCA
		REQUIRED	SAVINGS PROPOSED CHANGES TO STRUC	TURE BE SAVED
	CONDUCTION THRU: DOORS	REQUIRED	SAVINGS PROPOSED CHANGES TO STRUC	TURE BE SAVED



P · 0	INTS OF EMPHASIS.	Manual Page	Chart No.
(f)	JOB BOOK Page 7: Heat Losses by Conduction Through Walls		C-47
	(1) Enter Perimeter and Height of Outside Walls from page 1. Multiply to obtain Gross Wall Area. Subtract sum of areas of windows and doors from pages 5 and 6 to determine Net Wall Area.		
	(2) Insert District Heating Factor from page 1.	•	
	(3) From Table 1 on page 12 of Job Book, obtain "R" value for each material in walls. Add these "R" values to obtain composite value for the walls. Round off to nearest tenth of unit.		
	(4) Use these factors to determine the Required Heating Units, and enter on bottom line.	· / · ^	
	(5) In a similar manner, determine Potential Heating Units based upon an "R" value of well-insulated walls equal to 15.		
	(6) Subtract to determine Potential Heating Savings, and enter on bettom line.		-
		1.	
	End of Lesson No. 5B (Lesson No. 5C starts on page 42)	,	

Chart C - 47 (Form To Be Completed During Lesson)



	P o	INTS OF EMPHASIS	Manual Page	
1.	STEP	3 - EVALUATION OF THE DATA	12	C-48
	(a)	Fill out the Summary Table on page 8 by entering the "Heating Units Required" and the Potential Heating Savings" from the corresponding tables at the bottom of pages 2 through 7.		C-49
	(b)	Review the 12-point check list on pages 11 and 12 of the Manual to determine the most logical and practical winterizing measures.	11-12	
		(Lesson continued on page 44)	•	•

Chart C - 48

4-STEP PROCESS

- 1. INSPECTION OF THE BUILDING
- 2. CALCULATION OF HEAT LOSSES
- 3. EVALUATION OF THE DATA

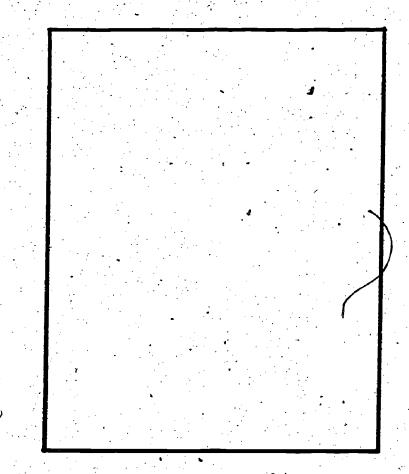


Chart C - 49 (Form To Be Completed During Lesson)

- 3 Use the instructions on page 11 of the FEA Winterization Manual to assess which potential savings can be obtained most successfully.
- Fill out the following Summary Table by entering the "Heating Units Required" and the "Potential Heating Savings" from the corresponding tables at the bottom of pages 2 through 7. Then, write in the "Proposed Changes" and "Heating Units to be Saved" by such changes.

HEAT REQUIREMENT ESTIMATES (Annual Heating Units Needed)

TYPE OF HEAT LOSS	. HEATING UNITS REQUIRED	POTENTIAL HEATING SAVINGS	PROPOSED CHANGES TO STRUCTURE	HEATING UNITS TO BE SAVED
INFILTRATION From Page 2	532	236	CAULK & WEATHER STRIP ALL DOORS & WINDOWS	236
CONDUCTION THRU: 5 FLOORS 5 Page 3	477	178	CAULK BASEMENT BANK WALL	178
CONDUCTION THRU: CEILINGS Page 4	203	110	ADO 4" INSULATION	110
CONDUCTION THRU: 7 SINGLE-GLASS WINDOWS Page 5	136	68	ADD PLASTIC STORM WINDOW	68
CONDUCTION THRU: DOORS & Page 6	90	0	NONE	0
CONDUCTION THRU: WALLS Page 7	142	39	NONE-WALLS CLOSED	0
TOTALS	1580	631		592

Use the space below to calculate the quantities and cost of materials needed to make the proposed changes to the building.

INSULATION

CEILING - 924 mg H - ORDER 1000 mg. H.

PLASTIC STORM WINDOWS

5 WIDE PLASTIC

4 4 8' 12'

1 × 5'= 5!

TO ORDER 26 + TAPE

BANKING

H'wide PLASTIC 33'+ 28'+ 38' = 94' - RDER 100' +)TAPE

WEATHERSTRIP

2 DOORS - 7x3' 17'FALH x2'34' OROFR 35'

CAULK

ARWAD TWINDOWS (2 DOORS = 122'+ BASEMENT - ORDER 5 TUBES

Fill in job sheet on opposite page.

PAGE. 8

Step 3 - EVALUATION

(Continued from page 42)

(Concinued, 110m page 42)		
POINTS OF EMPHASIS	Manual Page	Chart No.
(c) Enter these "Proposed Changes" and "Heating Units To Be Saved" in the Summary Table on page 8, and add up the three columns of figures.		(Ç-49)
(d) Use the lower half of page 8 to calculate the quantities and cost of materials needed to make the "Propos Changes to Structure" which you have specified in the Summary Table.	ed .	
(e) Fill Out "Job Sheet A" on page 9. (Insert carbon paper under table at top of page)		C-50
(1) Enter the Type, Quantity, Cost and Location for each item to be ordered. Enter Installation Diagram No. from Manual, as well as any Special Instructions regarding tools or methods.		
(2) Remove Job Sheet A from Job Bood by tearing along perforated line at left edge of page.	•	
(Lesson continued on page 46)		

JOB SHEET A

THIS PAGE IS REMOVABLE FOR USE AT JOB SITE

Name MARY PERKINS

Address 3 PINE STREET BANGOR ME

Type of Materials	Quantity Required	Estimated Cost	Location Where Materials Are To Be Installed (Walls, Ceiling, etc.)	Installation Diagram No.	Special Instructions
4" INSULA 16"- W/6 MB) #00 Sec	70-00	CEILINO	I-3	TAME SHEARS
Polystores 4mg4'wa		16.00	BANKING	8-1	
Poly. Yana 5'luar	2077.	- 4.00	WINDOWS	P-I	MEED KHIFE
2" MARKIN	3 mess	6.00	BANKING & WINDOWS	B-1 & P-1	/
CHULING Compone	6 Took	- 1	WINDOW & POOR FRAMES	C-1	GUN.
STEEP VANY	35 m	3.∞	Doors	5-2 \$ 3-4	N 660 Hannel
2					
	•				
	CIN	SERT CARBO	ON PAPER UNDER TABLE AT TOP OF PA	GE ONLY)	>

Map or directions for locating home:

ROUTE 222 FROM CENTER OF TOWN 1.5 MILES FIRST HOUSE ON LEFT AFTER CROSSING BRIDGE

WORK RECORD

Activity
Order Materials

Install Materials

Date 5/10/75 6/1/75 E.Hall S. Paul

ON Mitriel Ordered
Door Yet Weathersti

PAGE 9

LESSON PLAN NO.5C Step. 3 - EVALUATION

(Continued from page 44)

POINTS OF EMPHASIS	Manual Page	Chart No.
	•	
(f) Fill out lower half of Job Sheet on page 10	•	C-51
(1) Determine estimated Total Cost of materials used.		
(2) Enter Fuel Factor based upon information from page 1A.		
	•	
(3) Enter Heating Units Saved based upon the actual changes to structure.		
(4) Enter Price of Fuel from page 1A.		
(1) Direct little of fuel from page IA.		•
(5) Calculate Pay-Off Time. It should be less than three seasons. If it is not, check back to the	•	
most expensive changes to deter- mine if they are really worth the expense.		
	•	
	. et	
		-
End of Lesson No. 5C (Lesson No. 5D starts on page 48)		

JOB SHEET B

THIS PAGE IS RETAINED WITH JOB BOOK AS PERMANENT RECORD

Type of Materials	Quantity Required	Estimated Cost	Location Where Materials Are To Be Installed (Walls, Ceiling, Etc.)	Installation — Diagram No.	Special Instructions
A) of Bis	1000 SaFt	70.00	CEILING .	I-3	TAKE SHEETS
	100 Pr	16.00	BANKING	8-1	S
YMR.	20 Ft	4.00	WINDOWS	P-1	STAPLEZ
SAMA -	- 3ao us	6.00	BAMKING & WINDOWS	B-1 (P-1	
CING COND	6 Tuess	6.06	WINDOW & DOOR FRAMES	C-/	GUN CAUCING
NER YINNI	3557	3.00	Poors	5-5 \$ 5-4	NEED Hammer
•	•			*	
	Materials	Materials Required Materi	Materials Required Cost Housens 1000 Sapt 70.06 Truyusing 1000 Pt 16.00 Ymil. 20 Ft 4.00 Estima 3 Rous 6.00 King 6 Tuess 6.06 Mar 7100 S	Haterials Required Cost Installed (Walls, Ceiling, Etc.) Haterials Required Cost Installed (Walls, Ceiling, Etc.) Haterials Required Cost Installed (Walls, Ceiling, Etc.) Carlon Car	Materials Required Cost Installed (Walls, Ceiling, Etc.): Diagram No. ### Dear Property Cost Installed (Walls, Ceiling, Etc.): Diagram No. ###################################

7) PAY-OFF TIME

This is the number of seasons for fuel savings to pay off the cost of winterization.

105.00

Total Cost (from job sheet above)

1 X

Fuel Factor
Fuel Oil = 1
Natural Gas = 120
Electricity = 30

592

Total Heating Units Saved (From page 8) X 1.4

Price of Fuel Per gal, cu.ft.,KWH .44 Yes.

"Pay-off" Time (seasons) INVESTMENT

PAGE 10 .

(Continued from page 46)

	POINTS, OF EMPHASIS	Manual Page	
2.	Final step in the winterization process is INSTALLATION of Materials.	13	C-52
	Some members of class may be well versed in this activity.		
	Everyone will benefit by pooling our knowledge of the techniques that have proved to be most effective.		
	Method we will use to cover the highlights of this subject will be: (NOTE TO TEACHER - Refer to following page for suggested methods for Lesson 5D).		
		4	•

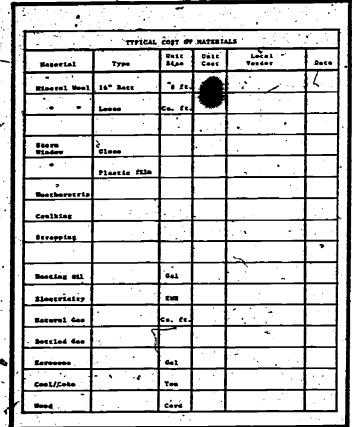
End of Lesson 5C (Lesson 5D starts on next page)

Chart C - 52

Chart C - 53.

4-STEP PROCESS

- 1. INSPECTION OF THE BUILDING
- 2. CALCULATION OF HEAT LOSSES
- 3. EVALUATION OF THE DATA
- 4. INSTALLATION
 OF THE MATERIALS



-l.

Es

NOTE TO TEACHER

- This subject, Installation of Materials, does not lend itself as well to the lecture method of instruction which was used in the previous lessons. The following methods which involve either laboratory exercises or classroom demonstrations are suggested for consideration by the teacher in preparing a Lesson Plan:
 - (a) Laboratory Exercises (Preferred Method)

 The laboratory exercises which begin on the following page represent the most effective method for teaching this subject to a class of students who have had some training and/or experience in carpentry.
 - (b) Classroom Demonstration (Alternative Method)

 If shop facilities are not available, the teacher may wish to conduct demonstrations in a classroom of the installation activities covered in the laboratory exercises.
 - Classroom Lecture (Optional)
 An Optional Lesson Plan on Installation, which utilizes approximately sixty 35mm slides, has been prepared for use when classroom facilities are not suitable for either laboratory exercises or classroom demonstrations. Several sets have been distributed to the State Energy Office in each state for use in the vocational-technical schools. In addition, a set is available on a loan basis from the Regional Office of the Federal Energy Administration.
- 2. LABORATORY EXERCISE ON INSTALLING INSULATION
 - (a) Objective: to give the students a hands-on experience in installing the common forms of insulation materials.
 - (b) Equipment and Materials Required:
 Wall frame mock-up
 Insulation (blanket or batt)

(Lesson continued on next page)

INSTALLATION

(Continued from previous page)

NOTE - TO - TEACHER

- (b) Equipment and Materials Required (continued)
 Stapler
 Shears
- (c) Suggested Procedure

 Demonstrate to class the proper methods for installing insulation in ceilings, floors, crawl spaces and
 masonry walls. Discuss vapor barriers and ventilating attics.

Have students (or teams) practice installing insulation on the wall frame mock-ups. (If small staples are used, the insulation can be carefully removed and reused).

LABORATORY EXERCISE ON INSTALLING WEATHER STRIPPING

- (a) Objective: to give the students a hands-on experience in installing weather stripping and other weatherizing materials.
- (b) Equipment and Materials Required

 Door and frame mock-up

 Weather stripping materials (several types)

 Caulking gun and tube

 Shears
 - Knife Hammer Stapler
- (c) Suggested Procedure (C) Discuss the selection of materials. Demonstrate to class the proper method for installing the materials.

Have the students (or teams) practice installing the wealtherizing materials to the mock-ups.

(Lesson continued on mext page)

(Continued from previous page)

NOTE, TO TEACHER

- 4. LABORATORY EXERCISE ON INSTALLING PLASTIC STORM WINDOWS
 - (a) Objective: to give the students a hands-on experience in installing plastic storm window.
 - (b) Equipment and Materials Required:

 Window frame mock-up

 Plastic sheeting
 Fastening materials:

 Wood strapping (and nails

 Masking tape and staples

 Tools:

 Shears, knife, hammer, saw, and stapler
 - Discuss the procedure, demonstrate to class and have students (or teams) practice installing plastic on wirdow frame mock-up.
- 5. FIELD ASSIGNMENT TO OBTAIN COSTS OF MATERIAL

Teacher should encourage students to phone or visit local suppliers to obtain current costs of common materials used in the winterizing process. A table for recording this information is provided in the student's Manual on page 27 (chart C-53).

End Of Lesson 5D

2:

NOTE TO TEACHER

1. PURPOSE OF LESSON

This lesson will enable the Teacher to evaluate the degree to which the instructional Objectives have been achieved.

EVALUATION OF INSTRUCTIONAL OBJECTIVE NO. 1 ESTIMATION

- (a) Objective: Given the physical dimensions and construction features of a detached residential structure, a student will prepare (for a homeowner) a written analysis (Job Book), containing the following:
 - Identification of gross thermal deficiencies of the structure which result in heat losses by infiltration and conduction;
 - (2) Comparison of current heating requirements with the potential savings;
 - (3) Job Write-up, from which material specifications and bill of materials will be prepared; and
 - (4) Bill of Materials for the feasible remedies, including costs and pay-back period.

-(b) Procedure

A preferred and an alternate procedure are suggested. The preferred procedure is a <u>field exercise</u> that involves the Inspection-Calculation-Evaluation steps of the 4-step winterizing process covered in Lesson Plans Nos. 5A, 5B and 5C. The alternate procedure is a <u>classroom exercise</u> that involves the Calculation-Evaluation steps only.

(c) Field Exercise

(1) Inspection: Arrange for class to visit a nearby home with simple construction characteristics (one-story, and simple floor plan).

(Lesson continued on next page)



(Continued from previous page)

NOTE TO TEACHER

- (c) Field Exercise (continued)
 Working independently, (or in assigned teams),
 each student will record the physical dimensions
 and constuction features called for in the Job
 Book on pages 1, 2, 3, 4, 7 and 9. (To insure
 uniformity, the teacher will provide the student
 with the dwelling and heating system information
 called for on page 1A.)
 - (2) Calculation-Evaluation: After returning to the classroom, the data obtained by students will be discussed by the class to resolve differences Then, each student will independently perform the calculations and evaluation called for in steps 2 and 3, and record the answers in the Job Book.

At the conclusion of the exercise, the answers will be compared and the differences discussed. (If appropriate, the Job Books will be collected by teacher for grading and/or evaluation purposes.)

(d) Classroom Exercise

- (1) Inspection: If field trip is not practical, this step will be omitted. Teacher will prepare an example of single-family home with simple features. Students will be given the physical dimensions and contruction features called for in the Job Book on pages 1, IA, 2, 3, 4, 7 & 9.
- (2) Calculation-Evaluation: Each student will independently perform the calculations and evaluation called for in Steps 2 and 3 of the 4-step winterization process, and record the answers in the Job Book.

At the conclusion of the exercise, the answers will be compared and the differences discussed. (If appropriate, the Job Books will be collected by teacher for grading and/or evaluation purposes.)

(Lesson continued on next page)

JOB BOOK EXAMPLE BY STUDENTS

(Continued from previous page)

NOTE TO TEACHER

3. EVALUATION OF INSTRUCTIONAL OBJECTIVE NO. 2: INSTALLATION

- (a) Objective: Given a job write-up (Job Book) for a detached residentail structure, the student will describe and/or demonstrate to others the proper methods for installing the specified materials.
- (b) <u>Procedure</u>: Due to the wide variety of possible instructional situations, no standard procedure will be given here.

An ideal procedure would be for the teacher to make arrangements thru a community services agency that is involved in winterizing homes, to have the class install the winterizing materials purchased by that agency.

If this is not practical or feasible, the teacher is encouraged to design an evaluation procedure based upon the method of instruction employed in lesson 5D.

End of Lesson No. 6

- PUBLICATIONS ON HOME WINTERIZATION

Retrofitting Existing Housing for Energy Conservation: An Economic Analysis. Washington, D.C.: U.S. Department of Commerce in cooperation with the Federal Energy Administration; December 1974. This study examines the economic aspects of energy conservation techniques suitable for retrofitting into existing housing, including insulation, storm windows and doors, and weather stripping. The objective of this study is to determine that combination of techniques that will maximize net dollar savings in life-cycle operating costs for heating and cooling operations in existing homes, subject to specific climate conditions, fuel costs, and retrofitting costs. Available from Government Printing Office, Catalog No. Cl3.29/2:64 \$1.35.

Insulation Manual, Homes/Apartments. Prepared by NAHB Research Foundation, Inc., Rockville, Maryland, September 1971. This 44-page manual provides complete information about insulation for residential buildings including application, comparative resistance values, weather data, and a simplified method of heating and cooling calculations. Available from National Mineral Wool Insulation Association, Inc., 382 Springfield Ave., Suite 312, Summit, New Jersey 07901, \$2.00.

How to Insulate Homes for Oil Heating, OH-603. Installation procedures, vapor barriers, and ventilation are covered in detail in this 24-page pamphlet measuring 4" x 9". Available from National Mineral Wool Insulation Association, Inc., \$0.25.

How To Save Money By Insulating Your Home, RI-500. Full instructions and advice on doing it yourself or hiring a contractor. Practical details on adding insulation to an existing home. Plus information on storm windows and doors, weather stripping and caulking are covered in this 24-page pamphlet measuring 4" x 9". Available from National Mineral Wool Insulation Association, Inc., \$0.30.

Blowing Wool Application Manual, BW-201. Designed originally for use by new employees of insulation contractors, this 20-page pamphlet measuring 4" x 9", published in September 1970, is used generally by those interested in the techniques of installing blowing wool pneumatically. Available from National Mineral Wool Insulation Association, Inc. No charge for single copies.

Impact of Improved Thermal Performance in Conserving Energy. An analysis by NMWIA members of energy savings accomplished by insulation and storm doors and windows on a national basis over a ten year period. Published in 1972, this 8-3/4" x 11" brochure is available at no charge from the National Wool Insulation Association, Inc.



PROJECT RETRO-TECH

HOME

WINTERIZATION

COURSE





INSTRUCTIONAL OBJECTIVES

ESTIMATION

STUDENT WILL PREPARE

WRITTEN ANALYSIS CONTAINING:

- (1) IDENTIFICATION OF DEFICIENCIES
- (2) COMPARISON OF REQUIREMENTS/SAVINGS
- (3) JOB SPECIFICATIONS
- (4) BILL OF MATERIALS

INSTALLATION

STUDENT WILL:

- (1) SUPERVISE APPLICATION
- (2) CONDUCT POST-EVALUATION



HOME WINTERIZATION COURSE

LESSONS

- A. INTRODUCTION TO HEAT LOSS
- B. BUILDING HEAT LOSS
 BY CONDUCTION
- C. BUILDING HEAT LOSS
 BY INFILTRATION
- D. 4 STEPS TO HOME WINTERIZATION



MOST HOMES

CAN USE

MUCH LESS FUEL

WITHOUT

SACRIFICING

COMFORT



IT IS NOT THE COLD

THAT COMES IN

IT IS THE

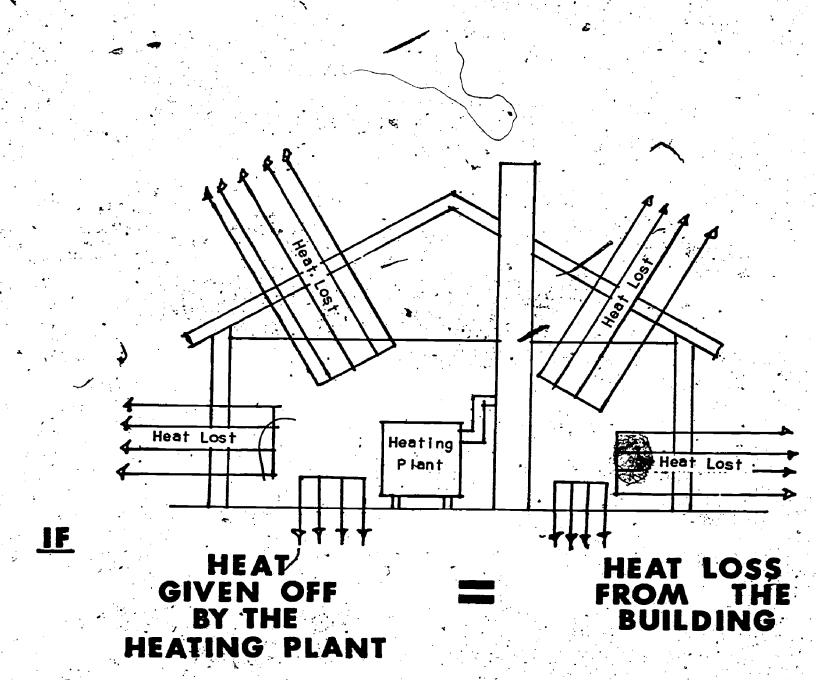
HEAT WE BUY

THAT ESCAPES

TO THE OUTSIDE

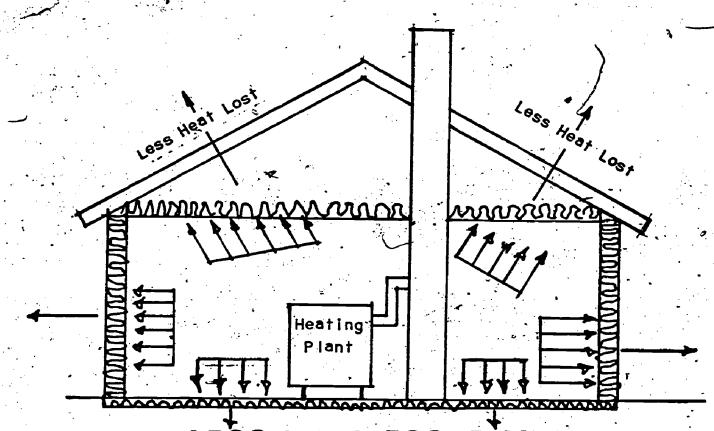


.CHART 5



THEN

TEMPERATURE INSIDE STAYS UP



LESS HEAT ESCAPING, MEANS LESS HEAT AND LESS FUEL NEEDED TO STAY COMFORTABLE INSIDE

ERIC .

CHART 7

1 British Thermal Unit (B.T.U)

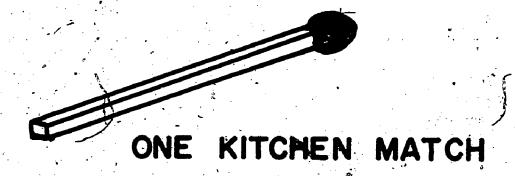
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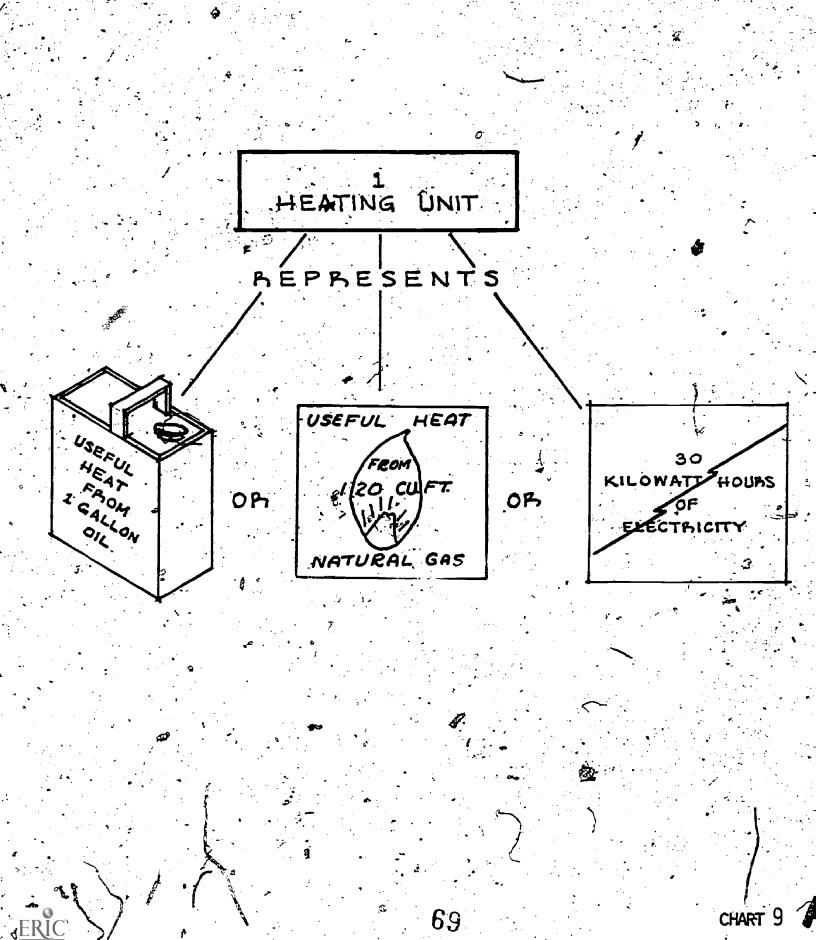
THE HEAT NEEDED TO RAISE ONE POUND .

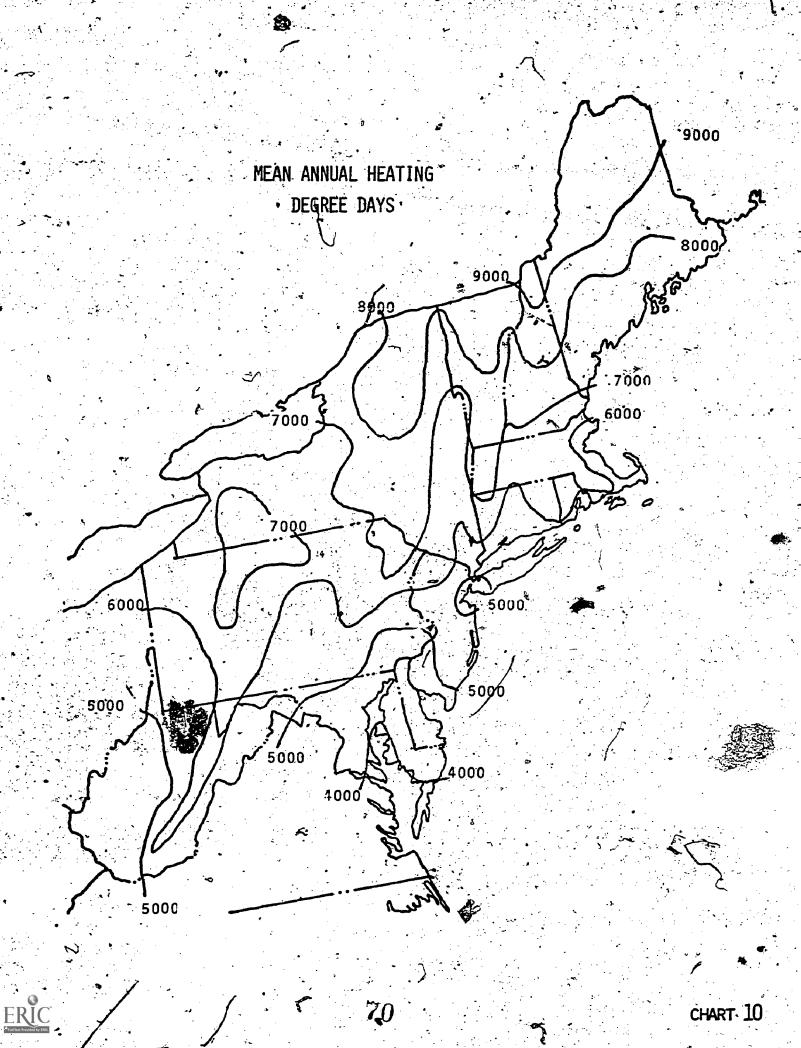
OF WATER ONE DEGREE FAHRENHEIT

--- APPROXIMATELY THE HEAT GIVEN

OFF BY BURNING

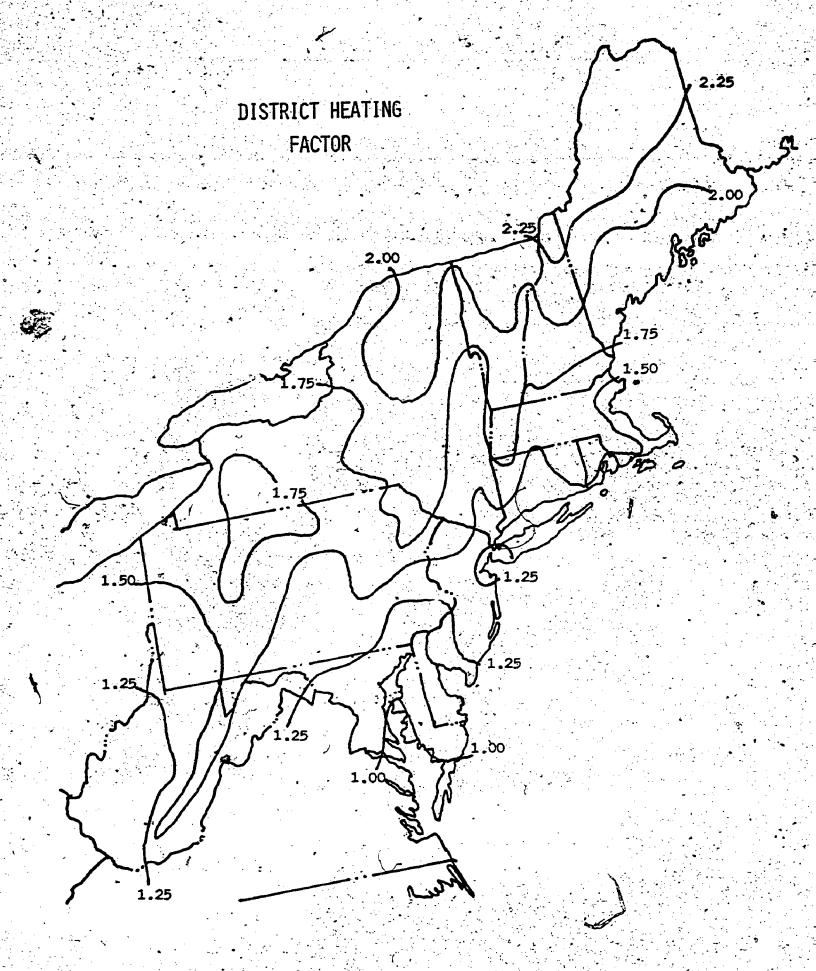






THE AREA HAS 4000 HEATING DEGREE DAYS THE DISTRICT HEATING · FACTOR IS

CHART 11





72

HOME

WINTERIZATION

IS A

4 STEP

PROCESS

ERIC

4-STEP PROCESS

- INSPECTION OF THE BUILDING 2. CALCULATION OF HEAT LOSSES 3. EVALUATION OF THE DATA
 - 4. INSTALLATION

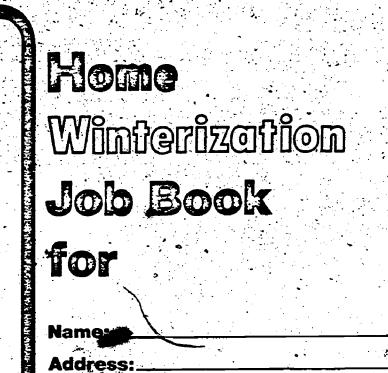
 OF THE MATERIALS



Federal Energy Administration Washington D.C.20461







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		•	,		

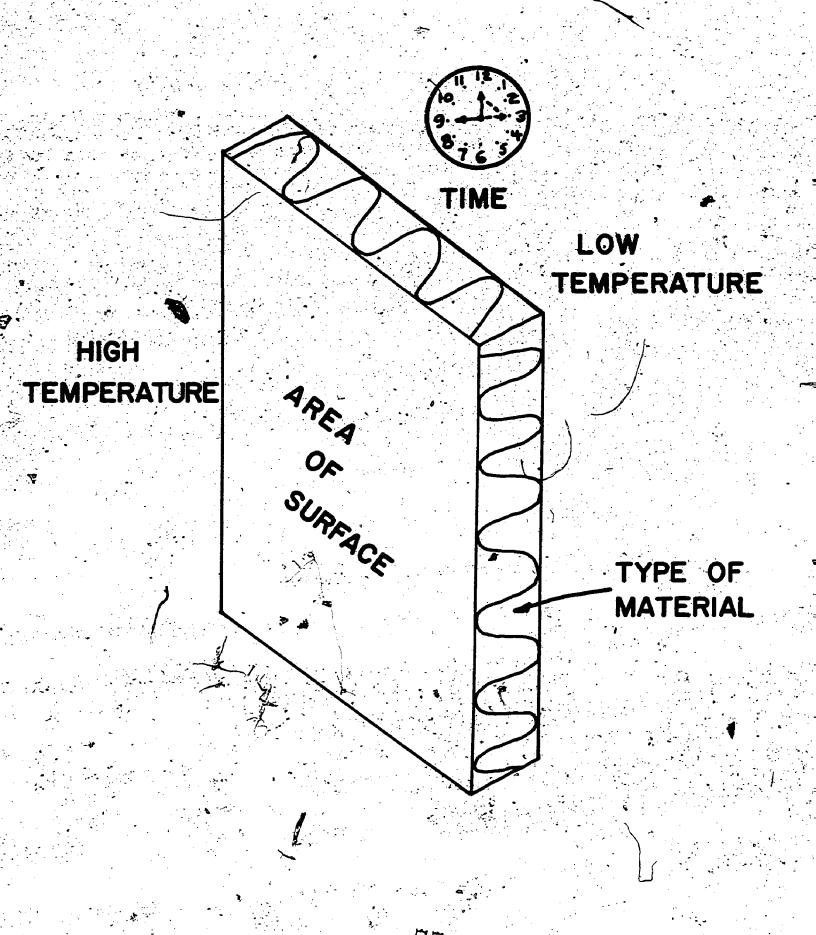
Assignment	Supervisor	Date Completed
HOME EVALUATION:		1
Field Inspection (pg. 1-7) Heat Loss Calculation (pg.	8)	
JOB SHEET (pg. 9-10):		
Order Materials Install Materials		
		CHART 1

CONDUCTION

THROUGH THE

EXTERIOR SURFACES

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TABLE 1. INSULATION VALUE OF COMMON MATERIALS

Source: ASHRAE Guide and Data Book

MATERIAL	<u>THICKNESS</u>	'R' VALUE
Air Film and Spaces		
Air space, bounded by ordinary materials Air Space, bounded by aluminum foil	3/4" or more 3/4" or more	0.91 2.17
Exterior surface resistance Interior surface resistance		0.17 0.68
Masonry	50	
Sand and gravel concrete block Sand and gravel concrete block Lightweight concrete block	12" 8"	1.11 1.28 2.00
Lightweight concrete block Face-brick Concrete cast in place	72" 4" • 8"	2.13 0.44 0.64
Building Materials - General		
Wood sheathing or subfloor Fiber board insulating sheathing Plywood	3/4" 3/4" 5/8"	1.00 2.10 0.79
Plywood Plywood Bevel lapped siding	1/2" 3/8" 1/2" x 8"	0.63 0.47 0.81
Bevel lapped siding Vertical tongue and groove board Drop siding	3/4" x 10" 3/4" 3/4"	1.05 1.00 0.94
Asbestos board 3/8" gypsum lath and 3/8" pla ster Gypsum board	1/4" 3/4" 3/8"	0.13 0.42 0.32
Interior plywood panel Building paper Vapor barrier	1/4"	0.31 0.06 0.00
Wood shingles Asphalt shingles Linoleum		0.87 0.44 0.08
Carpet with fiber pad Hardwood floor		2.08 0.71
Insulation Materials (mineral wool, glass wool,	wood wool, etc.)	
Blanket or batts Blanket or batts Blanket or batts	1" 3 1/2" 6"	3.70 11.00 1,9.00
Loose fill • Rigid insulation board (sheathing)	3/4"	3.33 2.10
Windows and Boors	and the second of the second o	
Single window Double window Exterior door	App	rox. 1.00 rox. 2.00 rox. 2.00

AIR FILM AND SPACES

MATERIAL	THICKNESS	"R" VALUE
AIR SPACE, BOUNDED BY ORDINARY MATERIALS	3/4" OR MORE	0.91
AIR SPACE, BOUNDED BY ALUMINUM FOIL	3/4" OR MORE	2.17
EXTERIOR SURFACE RESISTANCE	NIL	0.17
INTERIOR SURFACE RESISTANCE	NI	0.68

MASONRY

MATERIAL T	HICKNESS	"R" VALUE
SAND AND GRAVEL CONCRETE BLOCK	. 8"	1.11
SAND AND GRAVEL CONCRETE BLOCK	. 12"	1.28 .
LIGHTWEIGHT CONCRETE BLOCK	. 8"	2.00°
LIGHTWEIGHT. CONCRETE BLOCK	12"	2.13
FACE BRICK	4"	0.44
CONCRETE CAST IN PLACE	8"	0.64



BUILDING MATERIALS.

MATERIAL	THICKNESS.	"R" VALUE
WOOD SHEATHING OR SUBFLOOR	3/4"	1.00
FIBER BOARD INSULATING SHEATHING	3/4"	2,10
PLYWOOD	`\ 5/8 "	0.79
PLYWOOD	1/2"	0.63
PLYWOOD	3/8"	0.47
BEVEL LAPPED SIDING	1/2" x 8"	0.81
BEVEL LAPPED SIDING	3/4" 🛪 10"	1.05
VERTICAL TONGUE AND GROOVE	3/4"	1.00
Drop siding	3/4" .	0.94
ASBESTOS BOARD	1/3"	0.13
3/8" GYPSUM LATH AND 3/8" PLASTER	3/4"	0.42
GYPSUM BOARD	3/8"/	0.32
INTERIOR PLYWOOD PANELING	1/4"	.0.31
BUILDING PAPER		0.06
VAPOR BARRIER		0.00
WOOD SHINGLES		0.87
ASPHALT SHINGLES	·	0.44.
LINOLEUM		0.08
CARPET WITH FIBER PAD.		2.08
HARDWOOD FLOOR		0,71
		بر مسم کرا

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80-75

INSULATION MATERIALS

MATERIALS	THICKNESS	"R" VALUE
BLANKET OR BATTS	1"	3.70
BLANKET OR BATTS	3-1/2"	11.00
BLANKET OR BATTS	A contract of the contract of	and the second s
LOOSE FILL	1"	3,35
RIGID INSULATION BOARD (SHEATHING)	. 3/4"	2.10

WINDOWS AND DOORS

To simplify calculations, use the following approximate R

MATERIAL	"R" VALUE
SINGLE WINDOW	1.00
DOUBLE WINDOW	2.00
EXTERIOR DOOR	2.00

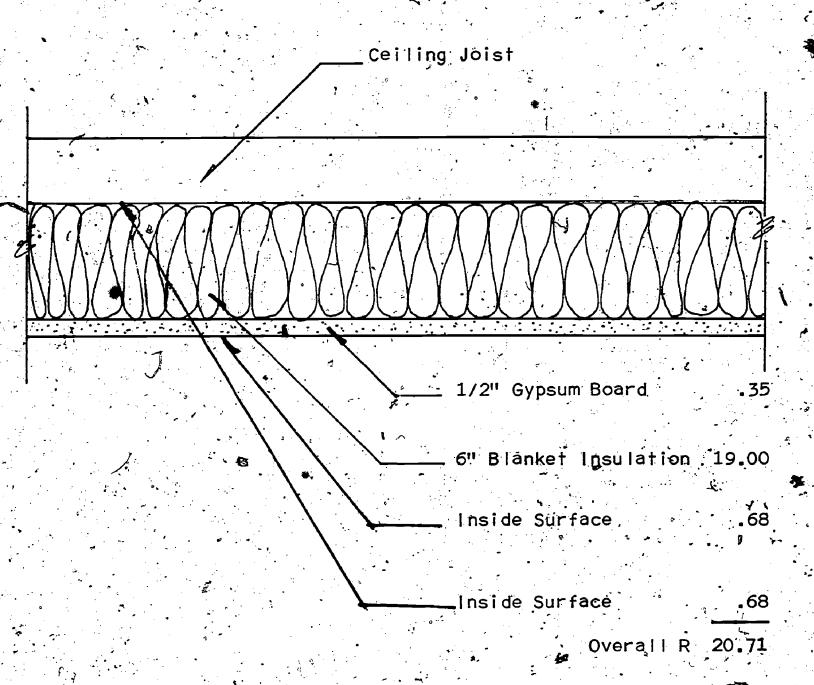
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HART 21

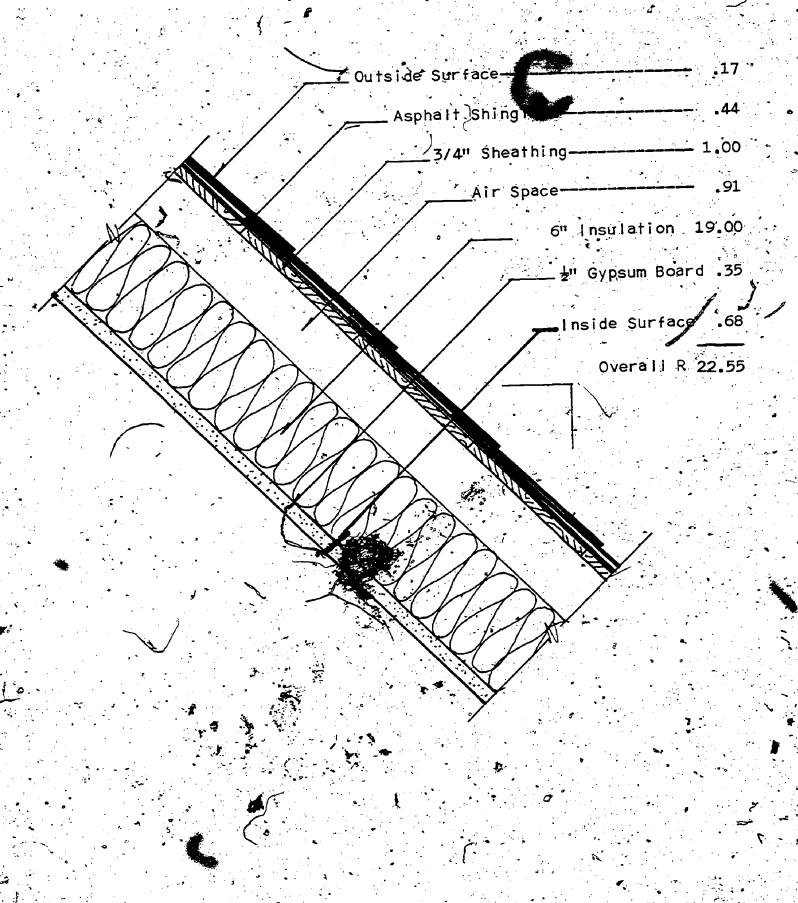
Interior Surface	•68
3/8" Gypsum Board	.32
3 1/2" Blanket Insulation	11.00
— 3/8" Plywood	> 47
Bevel Siding	.81
- Exterior Surface	.17

Overall R = '13.4

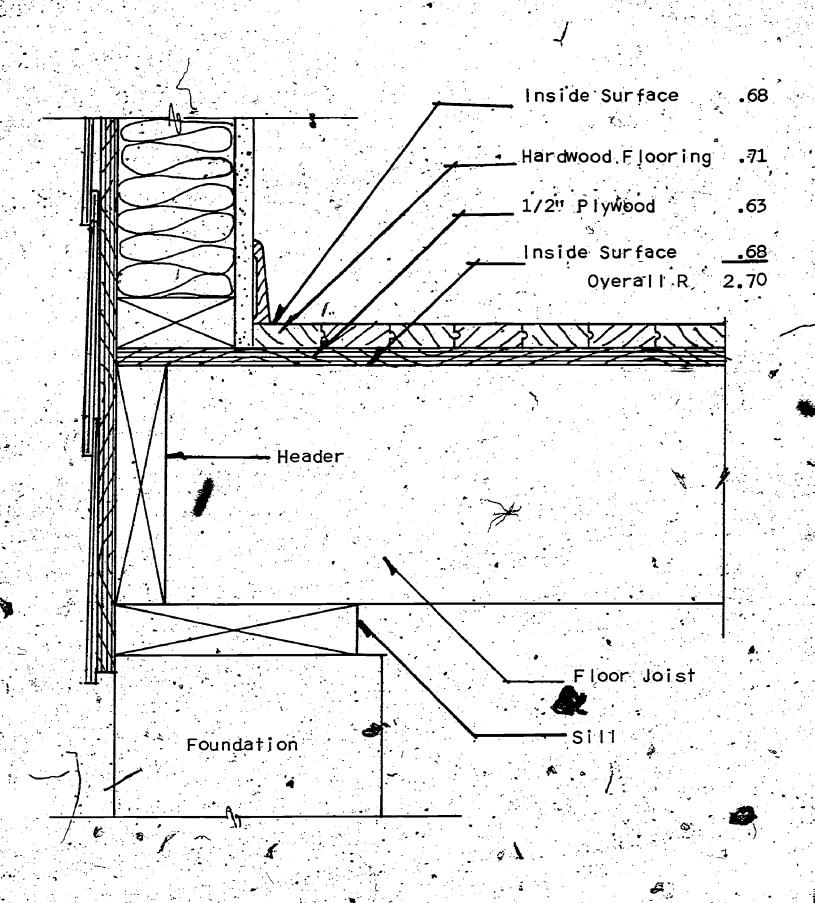
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OUTSIDE

OF TEMPERATURE

50% RELATIVE HUMIDITY

OI3 POUNDS PER SQUARE INCH VAPOR PRESSURE

> <u>LOW</u> PRESSURE

INSIDE

70° F TEMPERATURE 40% RELATIVE HUMIDITY

.150 POUNDS
PER SQUARE
INCH VAPOR
PRESSURE

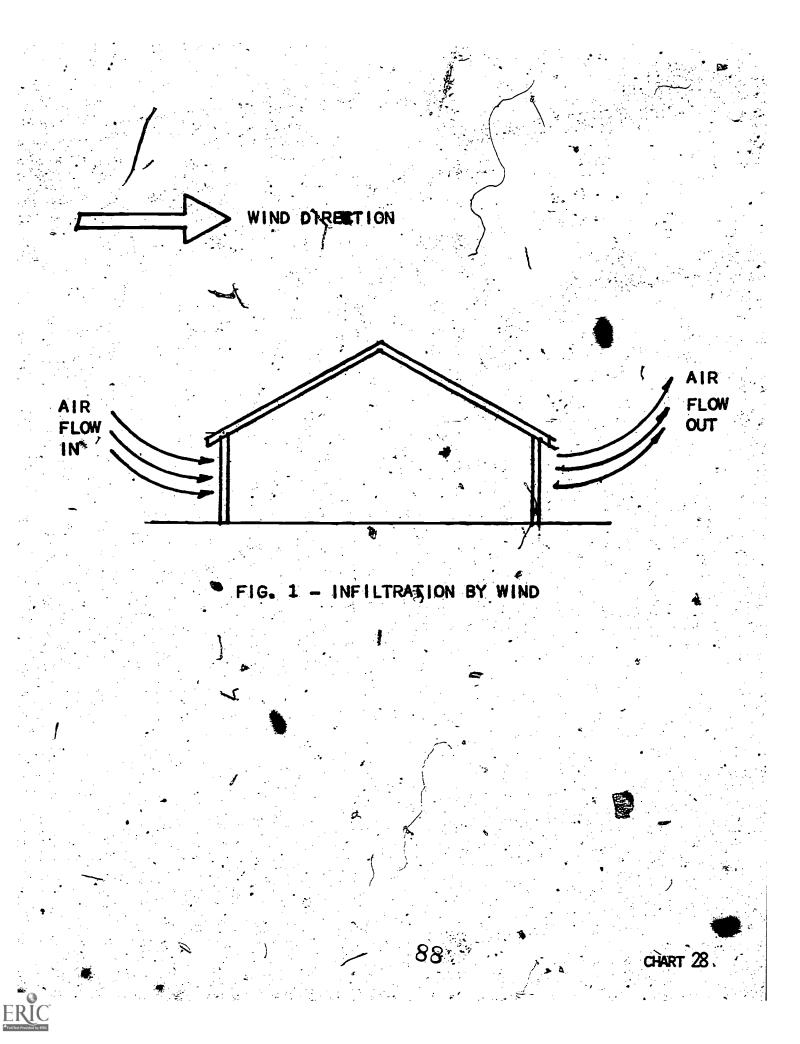
HIGH PRESSURE

INFILTRATION

HEAT LOST BY:

COLD AIR
COMING IN
AND
WARM AIR
GOING OUT

FRIC



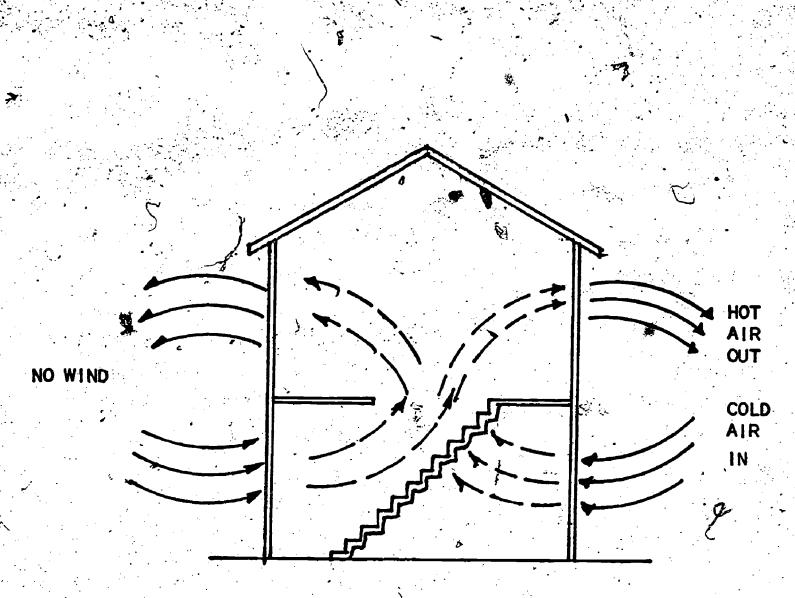


FIG. 2 - "CHIMNEY-EFFECT"

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B

BUILDING COMPONENT	ONE Air Change Per Hour	TWO Air Shange Per Hour	THREE Air Change Per Hour
CELLAR or CRAWL SPACE	Tight, no cracks, caulked sills, sealed cellar windows, no grade entrance leaks Plywood floor, no trap door leaks, no leaks around water, sewer and electrical openings	Some foundation cracks, no weather stripping on cellar windows, grade entrance not tight Tongue and groove board floor, reasonable fit on trap doors, around pipes, etc.	Stone foundation, considerable leakage area, poor seal around grade entrance Board floor, loose fit around pipes, etc.
WINDOWS	Storm windows with good fit	No storm windows, good fit on regular windows	No storm windows, loose fit on regular windows
DOORS	Good fit on Storm doors	Loose storm doors. O	No storm doors loose fit on inside door
WALLS :	Caulked windows and doors, building paper used under siding	Caulking in poor repair, building needs paint	No indication of building paper, evident cracks around door and window frame

90

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4-STEP PROCESS

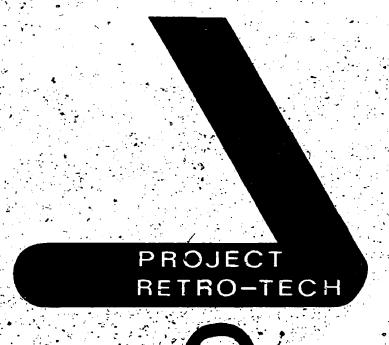
1. INSPECTION OF THE BUILDING

40 STEPS IN BUILDING INSPECTION

- 1. Take overall Building dimensions (Length, Width) Sidewall Height)
- 2. Measure windows (Height, Width)
- 3. MEASURE DOORS (HEIGHT, WIDTH)
- 4. CHECK CONDITION OF EXTERIOR

 (LOOK FOR CRACKS, LACK OF PAINT, CAULKING)
- 5. CHECK WALL CONSTRUCTION
- 6. CHECK CEILING, ROOF
- 7. CHECK FLOOR CONSTRUCTION
- 8. INSPECT FOUNDATION FOR CRACKS
- 9. CHECK FOR INFILTRATION, FEEL FOR DRAFTS, OPEN

 OUTSIDE DOOR QUICKLY (RESISTANCE MEANS A TIGHT FIT)
- 10. TALK TO THE OCCUPANT



Federal Energy Administration Washington D.C.20461



Home

Winterization

Job Book

for

Name: MARY PERKINS

Address: 3 PINE STREET

BANGOR, MAINE

WORK RECORD

Aşsıg	n m	eni	}
· • •			•

Supervisor

Date Completed

HOME EVALUATION:

Field Inspection (pg. 4-7)

Heat Loss Calculation (pg. 8)

ED. JONES

<u>5-Z-75</u>

JOB SHEET (pg. 9-10):

Order Materials Install Materials





DESCRIPTION OF BUILDING

Sketch all views and put dimensions on each part shows, e.g., length of walks, width and length of windows, etc. Label all single glass windows 5 and double glass and doors 0. Complete all items in the Job Book labeled "Fill in at Job Site."

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PAGE 1

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Continued from Opposite Page

DWELLING UNIT INFORMATION	HEATING SYSTEM INFORMATION
* NAME OF HEAD OF HOUSEHOLD MARY PERKINS	TYPE OF FUEL: (P = Primary) (S = Secondary)
* NAME & ADDRESS OF OWNER: (if got the same as above). MARY PERKINS	P Fuel 011 Natural Gas Bottled Gas S Wood
3 PINE STREET	Coal/Coke Kerosene
BANGOR, MAINE	Electricity Other (Specify)
* OCCUPANTS OF STRUCTURE:	(P = Primary) (S = Secondary)
Total Number 5	P Steam/Hot water/Hot Air S Fireplace/Stove/Portable Heater
One Story - Split-level	Electrical Baseboard
Two Story - Other (Specify)	Other (Specify)
2 1/2 Story	
* AGE OF STRUCTURE (Approx): 10 years	DOMESTIC HOT WATER: Does central heating system provide heat for domestic hot water?
* ROOMS IN LIVING SPACE:	
Total Number of Rooms	# THERMOSTAT SETTING IN WINTER (average):
Number Used in Winter	Day 65 Night 60 None
#. OCCUPANTS COMMENTS (e.g., drafty, cold floors, too expensive to heat, etc.).	* AMOUNT OF FUEL USED LAST HEATING SEASON: Pfimary Supplementary
FUEL BILLS TOO HIGH	Type FUEL OIL WOOD
DRAFTY WINDOWS	Quantity 1500GAL. I CORD
	Total Cost \$585.00 \$ 45.00
	# DISTRICT HEATING FACTOR 2
	DACE

ERIC

On pages 2 than 7, calculate the heat loss by Infiltration and by Conduction thru the separate parts of the building, and enter the results in the table at the bottom of each page, and in the Summary Table on page 8. HEAT LOSS BY, INFILTRATION Volume of Air in building HOUSE DRAFT INDEX: Opposite each of the four component parts of a building in the table below, place a check mark in the circle adjacent to the features which best describe the condition of the building. Floor Area BUILDING TWO THREE -2 COMPONENT Air Change Air Change Air Change ·Per Hour Per Hour Per Hour CELLAR Some foundation cracks, no weather stripping on cellar windows Tight, no cracks, Stone foundation. caulked sills, considerable leakage area, poor sealed cellar windows, no grade entrance leaks or: seal around ळ grade entrance grade entrance not tight CRAWL Plywood floor, no trap door leaks, Tongue and groove Board floor, loose SPACE board floor, reasonable fit on fit around pipes. no leaks around etc. water, sewer and electrical trap doors, around pipes, etc. openings Storm windows WINDOWS No storm windows, No storm windows, loose fit on good fit on regular windows with good fit regular windows DOORS Good_fit on Height .to ceil-Loose storm doors. poor fit on inside door No storm doors storm doors. loose fit on inside door ing (to upstairs ceiling in twospry house) WALLS Caulked windows Caulking in poor-repair, building No indication of building paper, evident cracks and doors; building paper used under needs paint around door and siding window frame MULTIPLY the number of check marks in the first column by 1, the second column by 2, and the third column by 3. The Draft Index will be the sum of these products, divided by 4. Heating Units _District Heating Volume Draft Index Factor-Now Required Potential Savinds by Reducing Infiltration it should be possible to reduce the draft index for a building to 1 (that is reduce the number of air changes to one per hour). If the draft index for this building was improved to 1, the infiltration loss would be: cu.ft. X District Heating Volume Potential Heating Units (from above) Factor Subtract the potential heating/units from those now required and enter here HEATING POTENTIAL HEATIN UNITS HEATING UNITS TO TYPE OF HEAT LOSS PROPOSED CHANGES TO STRUCTURE REQUIRED SAVINGS BE SAVED 11 w. INFILTRATION PAGE 2

Floor Cusavers Castan	ini yalua aker		
Floor Exposure Factor Select the proportate factor from the descript loss below:	List below all neglecting floo	materials in floor deck, r joists, starting from	including carpet but inside surface and work-
Building on posts or pillars with no skirts below floor	1.0 Insert 'R' valu	e for each component from	n Table !
Crawl space skirted	Material	Thickness 'R' V	lue
Rock wall basement	0.8 Interior Surfac		
More than two feet of base-	LINOLE		
ment wall exposed above grade (PLYW00		
Building on slab	SUB-FLOO	e 5/8"	-
Building with tight crawl space	٥.5		-
Building with tight base- ment (heated or unheated)	0.5		
4	Interior Surfac	e .68	
Floor Area (from Build- ing Descrip- tion) Floor Exposure Factor	Distric Heating Factor		Heating Units Required
Potential Savings on Floor Heat Loss Floors can sometimes be insulated to are below the floor may cause freezi protected from drafts, etc., so that this building, the heat loss through	reduce heat loss buing problems during voit has a floor expo	ery cold spells. However	. every floor should be
	1		
sq.ft.X O.5] X	_ ÷	
Floor Area Floor Exposure Factor	• Distric Heating Factor		, , , , , , , , , , , , , , , , , , , ,
Subtract the potential heating units	from those now requi	red and Enter Here	
	<u>*</u>		Potential Heating Savings
TYPE OF HEAT LOSS	HEATING POTENTIAL UNITS HEATING REQUIRED SAVING		HEATING UNITS TO BE SAVED
CONDUCTION THRU: FLOORS			

ERIC

PAGE 3

(Take area of upstair's ceiling in a two-story house)	• •			,		,	
normally be the same as floor area (from	- Materia	31 Ti	hickness	¹R¹ Value		5	7.
building description , sheet)	inside Surface	, '		68			F
•	GYPSU					, ·) 0
N.	FIBER	GLASS	2"		Distance b		a
	<u>. </u>		-+		joists/ra		=
					16	<u> </u>	L
•			•			,	2
	Inside Surface	(.68)					=
		NA		,′	1 1		
o							ノ間
sq.ft. X		<u> </u>					
· ·		1. •	S L		· ;		,
Ceiling Area	District Heating Facto	r	1	-To*tal R'Value	s .	Heating Units Required	i
Parkatini Caulan bu lanulatina	of Collinson	•	• :			,	
Potential Savings by Insulation of A well insulated ceiling (with 6		lation) show	de have a	n 'R' valu	ent 20 lifthi	s was so for t	his
building, the ceiling heat loss		30,10,11, 3,100					
	<u> </u>	_	·		• • • • • • • • • • • • • • • • • • • •		• .
sq.ft. X	,	1 <u> </u>	. [20			
Ceiling Area	- District	1 •	L	'R' Value	•	Potential	
	Heating Factor		•		· •	Heating Units	٠,٠
Subtract the potential heating un		now:require	d.and En	ter Here.	1		•
		•		.		Potential	
						Heating Savings .	
		•			S ₀	$\cdot : \underline{\Gamma}$	
•			•			,	
	HEATING UNITS	POTENTIAL HEATING	, ,		## P##!!##	HEATING UNITS TO	. ,
TYPE OF HEAT LOSS	REQUIRED	SAVINGS	PROPOS	ED CHANGES	TO STRUCTURE	, BE SAVED	1
CONDUCTION THRU: CEILINGS	<u> </u>	·		<u> </u>		·	1
		PAGE 4	*	1			- • ·

ERIC

HEAT LOSSES BY CONDUCTION THROUGH WALLS

Total Perimeter. of Outside Wall	'R! Value of Outside W		from in this day and
	including air spaces w each component (rom Ta	ifin the wall: Inse	rt 'R' value for
·	Material 🤌	·R·	
Total Height of Outside Warl	ft. Inside surface	Thickness Value	7 💆
	GYPSUM BOAR		 [
	AIR SPACE	3/4"	
Gross Wall Area	sq.ft. FIBERGLASS	2"	Z
	AIR SPACE	3/4"	-
-	SHEATHING	5/8	┥
Total Area of <u>all</u> Windows and Doors	ASBESTOS SHIND		-
(from previous two pages)	Outside sorface	17	1
<u> </u>			<u> </u>
Net Wall Area	sq.ft. X	<u>•</u>	
 3.	District Heating	Totali	Heating .n 's
*	Factor	'R' Value	
Potential Sevings' by Insulation			,
	* •		
Well insulated walls should have loss would be:	an 'R' value of 15. If this v	was so for fnis build	ing, the-wall heat
			· · · · · · · · · · · · · · · · · · ·
	Y -	<u>•</u> 15	
Net Wall Area	District Heating	'R' Value	rotentia
(from box above)	Factor		a. Heating Units
Subtract the potential hearing un	its from those now comparised an	d Enter Here	, , , .
			Potential
	7. (Heating Savings
			Javings
Ţ,			,
	•	•	
	•		
4			
HEAT UNI			HEATING UNITS TO
PPE OF HEAT LOSS REQU	IRED SAVINGS PROPOSED	CHANGES TO STRUCTUR	E BE SAVED
FION TURNS	į į	et e	
TION THRU: WALLS		•	
CITON THRU. WALLS	Page 7		•

CONDU

JOB SHEET A. THIS PAGE IS REMOVABLE FOR USE AT JOB SITE

2		•	\ .
Name	'		
1 :			
Address			·
AGG			

Type of Materials	Quantity Required	Estimated Cost	Location Where Materials Are To Be Installed (Walls, Ceiling, etc.)	Installation Diagram No.	Special Instructions
,					
		,			
			•	- 3	, •
		~			•
	r	1,			
	CIN	SERT CARBO	N PAPER UNDER TABLE AT TOP OF PA	AGE ONLY)	

Map or directions for locating home:

ROUTE 222 FROM CENTER OF TOWN 1.5 MILES,
FIRST HOUSE ON LEFT AFTER CROSSING BRIDGE.

WORK RECORD

Activity Order Materials

Install Materials

Supervisor

Date

Comments

PAGE 9



4-STEP PROCESS

1. INSPECTION
OF THE BUILDING
2. CALCULATION
OF HEAT LOSSES

, - *	* .			• •	- [
Volume of Air	HOUSE DRAF		S BY INFILTRATION	3	. (
Floor Area	ing in the	table below, place	each of the four compo a check mark in the c the condition of the b	ircial adiacent to the	_
sq.ff	BUILDING COMPONENT	Air Change Per Hour	TWO Air Change Per Hour	THREE Air Change Per Hour)
¥	CELLÁR . or	Tight, no cracks, caulked sills, sealed cellar windows, no grade entrance leaks	Some foundation cracks, no weather stripping on cellar windows, grade entrance not tight	Stong foundation, considerable leakage area, poor seal around grade entrance	
	CRAWL SPACE	Plywood floor, no trap door leaks, no leaks around water, sewer and electrical openings	Tongue and groove board floor, reasonable fit on trap doors, around pipes, etc.	Board floor, loose fit around pipes, etc:) - -
-	WINDONS	Storm windows with good fit	No storm windows. good fit on regular windows	No storm windows, loose fit on regular windows	
Height to ceif- ing (to upstairs ceiling in two-	DOORS	Good fit on storm doors	Loose storm doors, poor fit on inside door	No storm doors loose fit on inside door	
story house)	WALLS	Caulked windows and doors, building paper used under siding	Caulking in poor repair, building needs paint	No indication of building paper, evident cracks around door and window frame	
•	MULTIPLY the	number of check ma	arks in the first column	nn by 1, the second	/
	of these pro	ducts, divided by 4	inn by 3. The bratt II	ndex will be the sum	
Cu_ft Volume	of these pro	X	Heating X .OZ	Heating Units	
cu_ft	these pro	Index District	Heating X .OZ		, a
Volume Potential Savings by Re	Draft	Index District	Heating X .OZ	Heating Units Now Required	ā
Volume Potential Savings by Re It should be possible to	Draft ducing Infiltr o reduce the d	Index District Fac	Heating X .OZ	Heating Units Now Required	0
Potential Savings by Re It should be possible to changes to one per hour loss would be: cu.ft.	Draft ducing infiltr o reduce the da X	index District Factor ation aritimes for a buildiff index for this build	Heating X.OZ ing to 1 (that is reduce the sing was improved to 1, the X.OZ	Heating Units Now Required e number of air infiltration	0
Potential Savings by Re It should be possible to changes to one per hour loss would be:	Draft ducing Infiltr o reduce the d if the dra Draft	ation oraft index for a buildiff index for this build District	Heating X .OZ In Heating to 1 (that is reduce the ding was improved to 1, the ding to 1 the ding to	Heating Units Now Required	5
Potential Savings by Re It should be possible to changes to one per hour loss would be: Volume (from above)	Draft ducing Infiltr o reduce the d if the dra Draft	ation oraft index for a buildiff index for this build District	Heating X .OZ In Heating to 1 (that is reduce the ding was improved to 1, the ding to 1 the ding to	Heating Units Now Required e number of air infiltration	5
Potential Savings by Re It should be possible to changes to one per hour loss would be: Cu.ft. Volume (from above) Subtract the potential	Draft ducing Infiltr oreduce the do If the dra A praft heating units	ation oraft index for a buildiff index for this build District	Heating X.02 In Heating to 1 (that is reduce the ting was improved to 1, the tentang was imp	Heating Units Now Required The number of air Infiltration Potential Heating Units HEATING UNITS TO	5

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Area of Ceiling				· 3	
(Take area of upstairs	•	•.			•
ceiling in a two-story	· ·				
house)	v s ,		•	•	
Cellingwarea will :			• •		
normally be the same	**********	Thickness 'R' Val		, , , , , , , , , , , , , , , , , , ,	Y
as floor area (from	Material	Intekness 'R' val	iue .		M
building description	Inside Surface	.68			!
sheeth			-	•	SIT
	GYPSUM BOA	Φ 3/8		5	7
• • • • • • • • • • • • • • • • • • •	FIBERGLASS				m
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			joists	/rafters: .	JOB
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	7	 	→ . L _	<u>6"</u>]	AT
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*	Inside Surface (:68)	- .	1 '	1.	
			-1 -1		
	S : Coultier)				/=
		1	•		لنا '
•					
		· · ·			
sq.ft. X	. 1 -	<u> </u>	. ==		. ,
	<i>*</i>	·			· †
Ceiling Area	District	Total	•	Heating Units	
-	Heating Factor	'Ŗ' Valu	ue س	Required.	
	<u> </u>				
Potential Saxings by Insulation	of Ceilings	_		•	
) 	-		,		
A well insulated ceiling (with 6	inches of insulation)	should have an 'R' v	value of 20. If	this was so for this	
building, the ceiling heat loss	wogld pe:		•		_
	•		•	ه س	
	`	4 60	.		
sq.ft. X		<u> </u>			"
	*	181.111			
Ceiling Area	District Heating Factor	'R' Valu	ue,	Potential	
	near that the for			Heating Units	
		•	•	1	
Subtract the potential heating w	nits from those now req	uired and Enter He	re		
7.	~ ~	. 1		· .	
	•			Potential Potential	
		/9 /	,	Heating	
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7	$\frac{1}{L}$				<u>ئ</u>
		-			•
	HEATING POTENT			/ HEATING /	
• 1	HEATING POTENT! UNITS - HEATIN	سينف ر کا	r ±	- UNITS TO/	
TYPE OF HEAT LOSS ?	REQUIR SAVING	S PRO RO ŠED CHAN	IGES TO STRUCTURE	BE SAVED	v
		<u> </u>			-
CONDUCTION THRU: CEILINGS	, ,	ğ			
CONDUCTION TIME. CETERIOS	<u> </u>				•
	, PAGE 4	· ·	•		
,	, rough 4		• •	~	:

ERIC Foll fast Provided by ERIC

Single Glass Windows: If none, enter 0 = and go to next sheet on double windows and doors Width & Height x Number Area. TOTAL District Heating Units Heating Factor Required Potential Saving by Double Glazing Double glazi:g or adding storm windows will cut the heat loss by half, so divide heating units by two, and Enter Here Potential Heating Savings HEATING POTENTIAL HEATING UNITS HEATING . UNITS TO BE SAVED TYPE OF HEAT LOSS PROPOSED CHANGES TO STRUCTURE REQUIRED SAVINGS CONDUCTION, THRU: SINGLE-GLASS WINDOWS PAGE 5



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	•			ŕ	•				
	Are	es of Doubl	e Glass ar	nd Doors			• •	•	
	Width	x Height	x Number	= Area -].		•	p .	
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		. •					<u>.</u>		
		•	TOTAL	,	sq.ft X		÷ !	2 =	=
	•	•		 _		istrict	'R'	Yalue	Heating Units
	··				Heat	ing Factor			Required
	•							•	
	•	. •				. , .	-	•	
D			•	• •	••			•	
	<u>ential Sa</u> nle glazi		ndows cal	n be done	but is not	: usuall∨	practical		
I f	no change	e is made	in the w	windows, t entered he	he Potent	ial Saving	will be	Ŏ,	
		_		the "R" e-third of			ox, 3 and	the	
Pot	ential Sa	vings wi	ll be one	e-third of	the "Heat	ing Units	Require	1.*)	Potential Heating
	* ***		1			*	•		Savings
		ø	4 *		▼.			<i>y</i> .	
	- 1, -	•			• .	.`		,	*
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	(•		<u>.</u> :	, ,	•	•	
	•			—	·				
4 .	•			HEATING	POTENTIAL	•			HEATING
	TYPE OF HE	AT LOSS	<u>.</u>	UNITS REQUIRED	HEATING SAVINGS	PROPOSE	CHANGES T	STRUCTURE	UNITS TO BE SAVED
ONDUC	TION THRU: BLE-GLASS	DOORS &			1				
000	nrc-urvo5	u TIVONO			7	<u> </u>		<u> </u>	



HEAT LOSSES BY CONDUCTION THROUGH WALLS

of Outside Wall	including ai	its materials in wall r spaces within the nt for Fabte I	s, starting fro wall. Insert !	m inside and Rivalue for
×	. Maté	rial Thicknes	'R' s Value	
Total Height of Outside Wall	ft. Inside surf		68	<u>o</u>
	GYPSUM	BOARD 3/8"		
	AIR SPA		4	< L
	Sq.ft. FIBERS			Z
<u> </u>	AIR SP			- v
▲ Total Area of all	SHEATH			
Windows and Doors	sq. ff. ASBESTOS	SHINNES 1/4"	.sa·	· i
(from previous two pages)	g utside s∵rfa		.17	J
	-1 <u></u>			
Net Wall Area	sq.ft. X	-	=	= -
	District		, Tota:	Heating Units
	. Fac	tor	'R' Value	Required
Potential Savings by Insulation	on .			
Weil insulated walls should ha	ive an 'R' value of 15.	If this was so for	this building.	the wal: heat
loss would be:	÷		, , , , , , , , , , , , , , , , , , ,	
		<u>'</u>	9.6	_
] X [_		15 =	•
- Net Wall Are			'R' Value	Fotential .
•				
<u>Subtract</u> the potential hearing	units from those now r	equired and Enter H	lere	
•	•	- · ·		Potential
		•		Heating Savings
				<u> </u>
	• •			
	~		•	
	; ر)	_	
			-	
٠				•
	•			
	EATING POTENTIAL	•	•	HEATING
	UNITS HEATING EQUIRED SAVINGS	PROPOSED CHANGES T	O-STRUCTURE	UNITS TO BE SAVED
DUCTION THRU: WALLS				
DOULTON THROP MALLS	Page 7			
•	inage /	٠ ,		•

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4-STEP PROCESS

- 1. <u>INSPECTION</u>
 OF THE BUILDING
 - 2. CALCULATION
 OF HEAT LOSSES
- 3. EVALUATION OF THE DATA

- Use the instructions on page II of the FEA Winterization-Manual to assess which potential savings can be obtained most successfully
- Fill out the following Summary Table by entering the "Heating Units Required" and the "Potential Heating Savings" from the corresponding tables at the bottom of pages 2 through 7. Then, write the "Proposed Changes" and "Heating Units to be Saved" by such changes.

HEAT REQUIREMENT ESTIMATES (Annual Heating Units Needed)

TYPE OF HEAT LOSS	· ·	HEĀTĪNG UŅĪTS REQUIRED	POTENTIAL HEATING SAVINGS	PROPOSED CHANGES TO STRUCTURE	HEATING UNITS TO BE SAVED,
INFILTRATION	From Page 2		•		
CONDUCTION THRU:	Page 3		•		•
CONDUCTION THRU:	Page 4.				
CONDUCTION THRU: SINGLE-GLASS WINDOWS	Page 5	÷		-	
CONDUCTION THRU: DOORS & DOUBLE-GLASS WINDOWS	Page 6		1		
CONDUCTION THRU> WALLS	Page 7	•	, N	•	
τοι	TALS	,		1	-

Use the space below to calculate the quantities and cost of materials needed to make the proposed changes to the building.

Fill in job sheet on opposite page.

THIS PAGE IS REMOVABLE FOR USE AT JOB SITE

Name	. 🛎		-7		• •		- ~	· ·	·
Address				1	_	1		· ,	*
-		-	7		*	7		-	

	Type of Materials	Quantity Required	Estimated Cost	Location Where Materials Are To Be Installed (Walls, Ceiling, etc.):	Installation Diagram No.	Special Instructions
						,
· .			4	.1		,
			/			
•		4				
, -					<u> </u>	
٠.	7.	<i>*</i>	9			
شير.					6	:
•		-	-	et.		•
_		CIN	SERT CARE	ON PAPER UNDER TABLE AT-TOP OF PA	GE ONLY)	*

Map or directions for locating home:

ROUTE 222 FROM CENTER OF TOWN 1.5 MILES, FIRST HOUSES ON LEFT AFTER CROSSING BRIDGE.

	_	WORK RECORD	<u>-</u>	·	·		<u> </u>
Activity	Date , ,	Supervisor '	•		Commer	its	
•Order Materials				æ. j	·\$,	7	<u>-</u>
Install Materials				*	- 6.	· · ·	·

PAGE 9



FILL, IN AT JOB, SITE

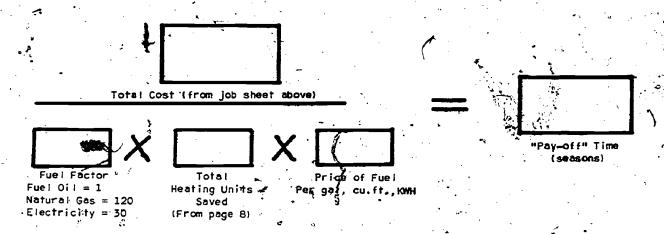
JOB SHEET B

THIS PAGE IS RETAINED WITH JOB BOOK AS PERMANENT RECORD

Type of Materials	Quantity Required	Estimated Cost	Location Where Materials Are To Be Installed (Walls, Ceiling, Etc.)	Installation Diagram No.	Special Instructions
	1				
<u>,</u>	•	,			
	Total, Cost	•			**

PAY-OFF TIME

This is the number of seasons for fuel savings to pay off the cost of winterization.



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4-STEP PROCESS

- 1. INSPECTION
 OF THE BUILDING
 - 2. <u>CALCULATION</u>
 OF HEAT LOSSES
 - 3. EVALUATION
 OF THE DATA
 - 4. INSTALLATION
 OF THE MATERIALS



	TYPICAL	COST OF	MATERI	ALS	
Material	Type.	Unit Size	Unit Cost	Local Vendor	Date
Mineral Wool	16" Batt	8 ft.	,		
n .n.	Loose	Cu. ft.			
•		•	7		
Storm Window	Glass		34		
".	Plastic film	•	9.		
Weatherstrip		New Year			
Caulking		1			
Strapping		5 1	•		
	\$			2	
Heating Oil		Gal (,		-
Electricity		кин			
Natural Gas		Cu. ft.	,		
Bottled Gas		•			
Kerosene	\$	Ga1	-		43
Coal/Coke	*	Ton	_		•
Wood		Cord			





This HOME WINTERIZATION MANUAL was developed for the Federal Energy Administration

bу

Richard Hill, Professor Mechanical Engineering, University of Maine Charles W. Kittridge, Extension Agricultural Engineer, University of Maine Norman Smith, Professor Agricultural Engineering, University of Maine

It is intended for use in inspecting and evaluating homes to determine if winterization measures are needed and gives directions for applying winterization materials.

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	<u>Page</u>
Introduction to Heat Loss.	. 1
Building Heat Loss by Conduction	. 4
Insulation Value of Materials	. 6
Building Heat Loss by Infiltration	7
District Heating Factor Map	. 8
Home Winterization in 4 Steps:	
Step No. 1 - Inspection of Building	. 9
Step No. 2 - Calculation of Heat Loss	10 -
Step No. 3 - Evaluation of Data	: 11
Step No. 4, - Installation of Materials	. 13 -
Example of Completed Job BookFollows	12 -
District Heating Factor Map - United States	. 26
Typical Cost of Materials	. 27

JUNE 1975

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BEING COMFORTABLE IN WINTER MEANS WARM AT MINI



This takes hear, which comes from fuel, which costs a whole lot more than it once did.

MOST HOMES CAN USE MUCH LESS WITHOUT SACRIFICING COMFORT

This manual explains the how and why of winter comfort heating. It provides an easy method of approximating how much heat will be needed to keep any particular building warm and explains how to assess the benefits of improvements made to the building, such as adding storm windows, insulating ceilings, excluding drafts, etc.

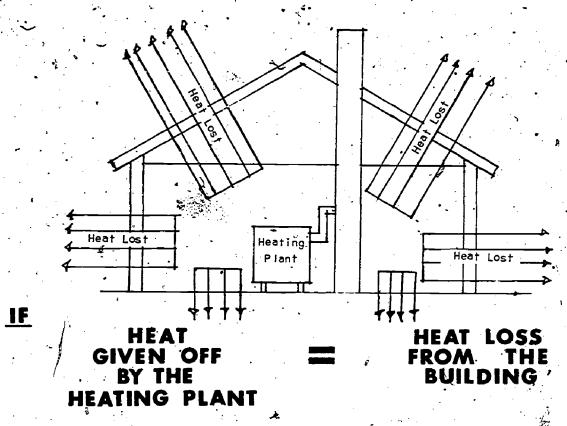
Most such improvements cost money. Mally they save more than they cost. In the mext few pages we shall see how to make heating improvements and how to figure the heat saved.

One, basic premise that we must get straight

IT IS NOT "COLD" THAT COMES IN--IT IS THE HEAT WE BUY THAT ESCAPES TO THE OUTSIDE

Heat always tends to flow from wherever the temperature is higher to wherever the temperature is lower. For example -- put a pan of cold water on a hot stove and heat flows from the stove through the bottom of the pan into the water, heating it up to a higher temperature. Pan bottoms are, therefore, made of materials which CONDUCT heat easily. To keep the pan from losing heat after it comes off the stove we can stand it on an asbestos pad--a material which RESISTS passage of heat, or in other words, provides INSULATION.

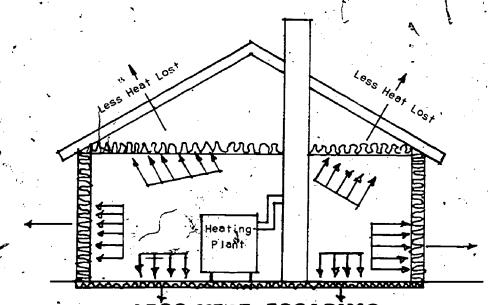
In just the same way as heat escapes from a pan of hot water, heat will pass out of 🙎 a heated building to the cold outside surroundings. If we want to keep the building at a comfortable température, we must release heat into it at the same rate at ich heat escapes out of the structure. Heating buildings is really as simple as "at."



THEN

TEMPERATURE INSIDE STAYS UP

Make it more difficult for heat to escape from a building by insulating, double glazing or sealing cracks and less heat will be needed to maintain comfortable temperatures inside the building. And less heat required means less fuel used, which means money saved.



LESS HEAT ESCAPING MEANS LESS HEAT AND LESS FUEL NEEDED TO STAY COMFORTABLE INSIDE

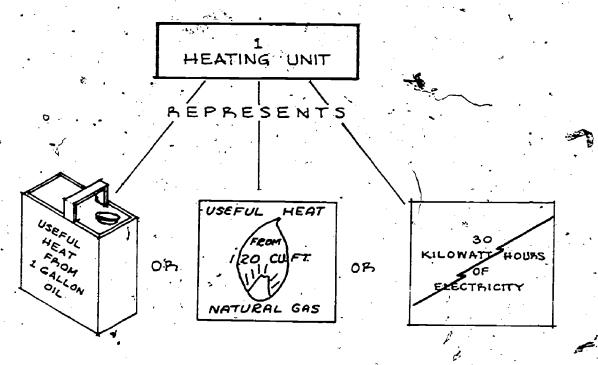
Heat escapes from a building in two ways, by CONDUCTION and by INFILTRATION.

In the next few pages, these processes will be explained—but first some definitions to make everything clear.



We must have a unit to measure heat losses. Normally we use the British Thermal Unif—BTU. This is the amount of heat it takes to raise the temperature of one poend of water by 1 "Fahrenheit. Another way of "sizing" a BTU is to say it is about the amount of heat given off when a wooden match is burned completely. All fuel values or heat requirements can be expressed in BTU's. For example, using one-kilowatt hour of electricity releases 3412 BTU's, one pound of wood burned completely will give off about 8000 BTU's, etc.

Working with BTU's means doing calculations with large numbers in which it is easy to make errors. This manuar uses the concept of Heating Units to simply the figuring.



Obviously, the <u>Heating Unit</u> is an approximation, because not all oil or gas heating plants operate at the same efficiency. However, the <u>Heating Unit</u> is a fairly accurate estimate of what a normal oil or gas furnace should get out of the quantities of those fuels illustrated above. The <u>Heating Unit</u> does, in fact, represent about 100,000 BTU s.

In this manual, we calculate heating requirements on a seasonal basis. Therefore, if a building is calculated to require 1200 Heating Units, that figure will represent the approximate number of gallons of oil it should use per year, if it has an efficient furnace. If the actual fuel use is known and is very different from the calculated figure, a further check needs to be made to find the reason. It may be due to calculation errors, wrong measurements in the building, or the furnace may not be functioning correctly. It may be that the building has only been partially heated previously, with much of the living space not used in the winter. Working with Heating Units in this way can enable us to spot errors or circumstances we might otherwise miss. Incidentally, if the furnace which provides heat for the building also provides domestic hot water, this will increase the fuel usage approximately 20%.

To allow for climatic differences between areas, heating engineers use Degree Day figures, one degree day representing a 24 hour period in which the average outside temperature is 1° F below a base temperature of 65 °F. Many northern areas will have over 7000 degree days in a heating season—once again a large number. This manual uses the <u>District Heating Factor</u> which, for an area with 4000 heating degree days, will be 1, for 6000 degree days 1.5, and so on. The map on page 8 shows the <u>District Heating Factors</u> for various areas. Simply look up the appropriate factor for your area and use it in figuring all heat losses for any house in your district.

Home winterization requires four steps to determine what should be done, where and how:

- 1. INSPECTION of the building to determine construction.
- 2. CALCULATION of heat losses from the building.
- 3. EVALUATION of the building and heat losses to determine what winterization measures should be made.
- 4. INSTALLATION of the winterization materials.

A Job Book is used for recording the information on each building. It also shows the procedure for calculating and summarizing heat loss and serves as an order form for listing and procuring materials.

BUILDING HEAT LOSS BY CONDUCTION

Heat is lost-from the home through the exterior surface of the building by heat flowing by conduction through the building materials. The rate of heat loss from the warm side to the cold side through the exterior surface depends upon the size of the surface, the length of time the heat flow occurs, the temperature difference between the two sides of the exposed area, and the construction of the section, that is the type of material used in the construction. All materials used in building construction reduce the flow of heat. Some materials are much better than others at reducing heat flow. The more effective materials are used as insulation.

Insulation

Three general types of insulating materials are commonly-used in building construction. They are loose fill, blanket or batt, and rigid insulation.

Loose fill types of insulation include glass, rockwool, cellulose fibers, wood fibers, and others. Fill type insulating materials are best utilized on horizontal surfaces, such as ceiling areas. This type of insulation used in vertical areas tends to settle, and unless provision is made to refill the space, cold spots can occur.

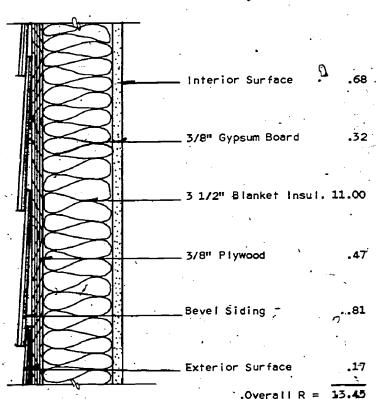
Blanket, or batf insulation, is commonly made of glass or rockwool, or wood fiber. They are usually enclosed in a paper envelope or fastened to a backing of kraft paper or aluminum foil. Some blanket types, of insulation have no backing and are intended to be used when no vapor barrier is required. Blanket insulation comes in rolls of various lengths and thicknesses. Batt—insulation—is—usually thicker and comes in shorter lengths. Both blanket and batt insulation are available for framing spacing of 16 and 24 inches. Other widths are available on special order.

Rigid insulation, in addition to providing insulating value, also provides structural strength. Rigid insulation is available in board form, such as various fiberboard materials, and formed plastics. This type of insulation is more expensive and is usually not used for home winterization.

Table 1 lists the insulating value of most of the common material found in house construction. The 'R' value shown in the righthand column indicates the effectiveness, or resistance value of the material. The higher the resistance value, the better its insulating quality. When building sections are made up of several materials, the resistance value of each of the individual materials can be added together to obtain the overall total resistance value. Once you know the overall 'R' value you can use it in the calculation outlined in the Job Book to determine heat loss. Thicknesses of 3 1/2 inches (R-11) and 6 inches (R-19) are most common.

Exterior Walls

To determine the insulating value of an exterior wall section, it is necessary to know the construction of the wall. Using Table I, determine the 'R' value for each material making up the wall. Add together these values to obtain the overall 'R' value of the wall.

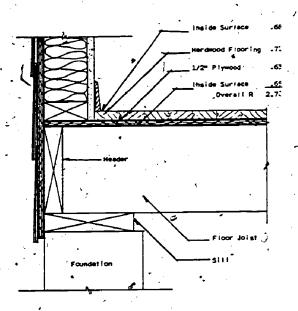


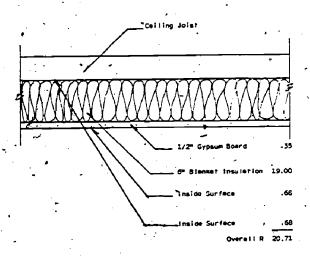
Ceilings and Roofs

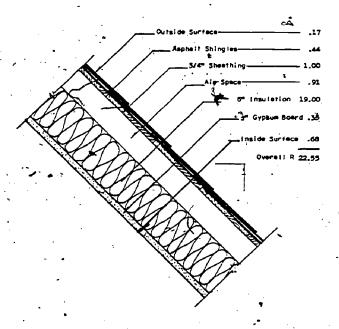
The insulating value of roof and ceiling sections can be determined by adding the 'R' value of each of the materials making up the section. It is necessary to know the construction of the ceiling or roof section. Add together the 'R' values of the materials making up the section from the values given in Table 1 to obtain the overall 'R' value of the section. For ceilings with attic space over the insulation, use an interior surface resistance, for the surface next to the attic due to the fact that still air conditions exist on the outside of the insulation. The illustration at the right shows the procedure for determing the overall resistance value for ceiling sections.

Į

For roof sections, the procedure determining overall resistance value are similar to the wall section. First, determine the construction of the roof section and then add the resistances of the individual materials making up the roof section to obtain the overall 'R' value for the roof. The diagram at the right shows the procedure for determining the overall 'R' value for roof areas.







F loors

To determine the insulating value of floors, add the 'R' value of the individual materials making up the floor section together to determine the overall 'R' value. Use the interior surface resistance for the surface next to the basement or crawl space area. The heat loss from floors depends upon the temperature below the floor. Basement and crawl space temperatures depend upon the quality of construction. In calculating floor heat loss in this manual a floor exposure factor is used to estimate changes in floor heat loss; due to different types of foundation construction.

Vapor Barriers

In the winter, moisture moves from the inside of the home to the outside through the exterior surfaces. Vapor barriers are installed to reduce the flow of moisture through the insulation so that condensation will not occur. Blanket or batt insulation usually has vapor barriers attached. Polyethylene film (4 mil) can be used as a separate vapor barrier if needed. Vapor barriers should always be installed on the warm side (inside) to stop the moisture before it reaches the insulation. If possible, vent the cold side of the insulation to the outside to remove moisture which escapes through the insulation. When blanket or hatter insulation with an attached vapor barrier is used, kraft paper backing is usally cheaper and just fective as foil backing.

TABLE 1. INSULATION, VALUE OF COMMON MATERIALS

Source: ASHRAE Guide and Data Book

MATERIAL	<u>TĤICKNESS</u>	'R' VALUE
Air Film and Spaces		
Air space, bounded by ordinary materials Air Space, bounded by aluminum foil	3/4" or more 3/4" or more	0.91
Exterior surface resistance Interior surface resistance		0.17 0.68
<u>Masonrý</u>		
Sand and gravel concrete block Sand and gravel concrete block Lightweight concrete block	8" 12" 8"	1.11 1.28 2.00
Lightweight concrete block Face brick Concrete cast in place	12" 4" 8"	2.13 0.44 0.64
Building Materials - General		· · · · · · · · · · · · · · · · · · ·
Wood sheathing or subfloor Fiber board insulating sheathing Plywood	3/4" -3/4" 5/8"	- 1.00 - 2.10 0.79
Plywood Plywood Bevel lapped siding	1/2" 3/8" 1/2" x 8" •	0.63 0.47 0.81
Bevel lapped siding Vertical tongue and groove board Drop siding	3/4" x 10" 3/4" 3/4"	T.05 1.00 0.94
Asbestos board 3/8" gypsum lath and 3/8" plaster Gypsum board	1/4" 3/4" 3/8"	0.13 0.42 0.32
Intertor plywood panel Building paper Vapor barrier	- 1/4"	0.31 0.06 0.00
Wood shinales Asphalt shingles Linoleum		0:87 0.44 0.08
Carpet with fiber pad Hardwood floor		2.08 0.71
Insulation Materials (mineral wool, glass woo	l, wood wool, etc.)	•
Blanket or batts Blanket or batts Blanket or batts	1" 3.1/2" 46"	,3.70 11.00 19.00
Loose fill Rigid insulation board (sheathing)	7" 3/4"	3.33 2.10
Windows and Doors		
Single window Double window Exterior door	Approx	1.00 2.00 2.00

Any building will constantly exchange air with its environment—outside air leaks in—inside air leaks out. A certain amount of this exchange (say one complete air change per hour) is necessary for ventilation, but most buildings have much more than is needed. In winter, the air that leaks in is cold; the air that leaks out is warm; fuel is consumed to supply this temperature difference.

This leakage or infiltration is caused by wind, the building acting as a chimney, and the opening of out-





FIG. 1 - INFILTRATION BY WIND

The effect of door openings and wind needs little explanation; but the chimney effect may not be obvious. When air in a building is warmer than the outside air, the entire building acts like a chimney—hot air tends to rise and leak out of cracks at the upper levels and suck cold air in through cracks at the lower levels. Both the temperature difference and building height contribute to this effect. A two party produce with a 68°F inside temperature and a 30 F outside temperature will produce a "chimney" leakage and to a ten mile per hour wind blowing against the building.

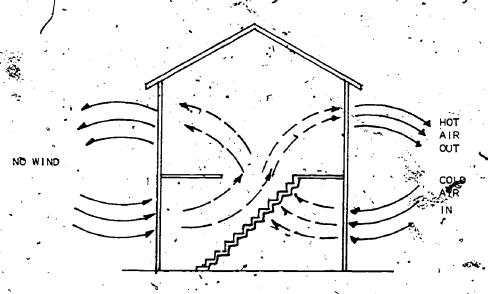
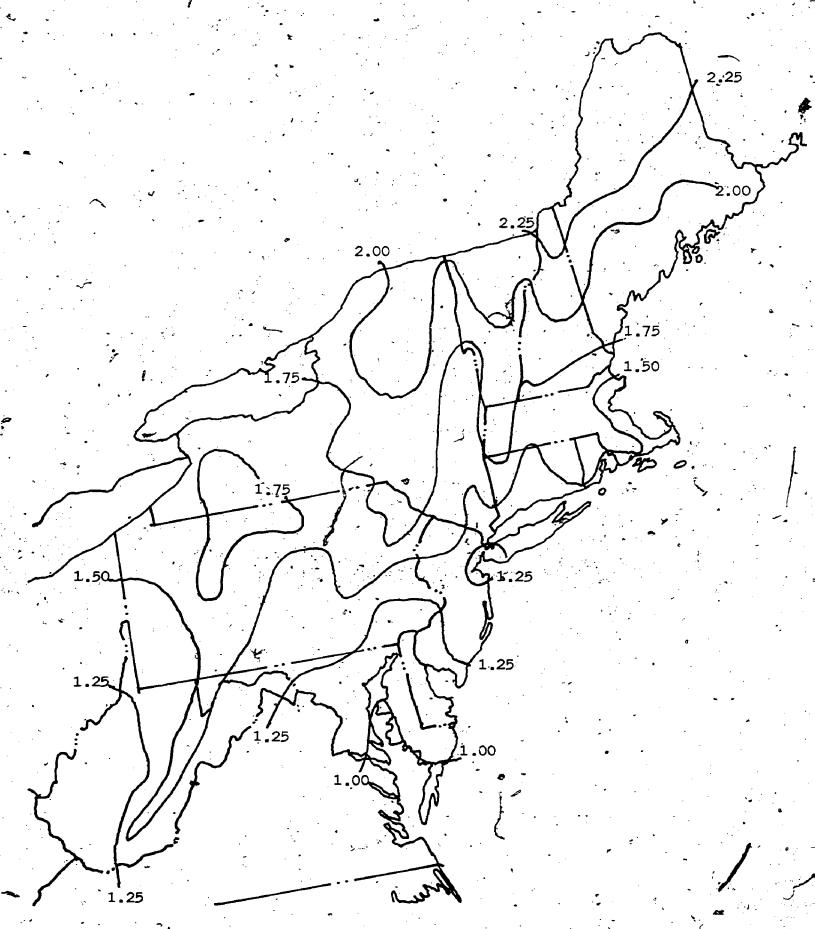


FIG. 24 "CHIMNEY-EFFECT"

Each cubic foot of air that enters the house requires approximately .02 BTU to raise the temperature 1°.F. To determine the heat loss from infiltration, it is necessary that the rate of air movement through the home be known. Most houses vary from one to three air changes per hour, depending on construction. An infiltration check list is provided to determine the approximate infiltration rate.









NORTHEAST REGION 123

HOME WINTERIZATION: STEP 1 - INSPECTION OF BUILDING

When you Visit the House

A thorough inspection of the house is necessary in order to secure the details for determining winterization measures. Check the house as thoroughly as possible and make sure that all the details described below are collected before you leave. If you find unusual circumstances in house construction, location, building arrangement, or other features that need to be taken into consideration, make notes on page 1 of the Job Book for future reference.

- 1. Measure the outside of the house, the length, the width, the height of the sidewalls. Draw a sketch of each side of the house and a floor plan on page 1 of the Job Book. Note the dimensions. It is not necessary that you measure the building to the last inch. If you find that you do not have access to some of the dimensions, estimate as close as possible. You will find that it is accurate enough for your calculations.
- 2= Check the doors and windows. Sketch them in on page 1 of the Job Book in their proper location, noting their construction, with an single window or door and a for a double window or door. If you do not have access to a window, estimate its dimensions. Otherwise, measure, and worte the sizes in the Job Book.
- 25. Check the construction of the exterior of the home. Check the construction of the walls, the exterior ceiling, roof and floor surfaces. It is necessary to know what kind of materials make up these areas in order to determine how well they are insulated. If you cannot readily determine this, ask the occupants. If the don't know then you may be able to find out by taking off a switch plate or a plate over an outlet box on the exterior wall to examine the inside of the wall. However, if you have difficulty finding what is in the wall or ceiling, chances are that you can't do anything about it anyway. Once you have found the construction material for the exterior surface, list the construction materials in the Job Book under walls, ceiling and roof, or floors, pages 3, 4, and 7. Note the material and thickness of the material so that you can later determine its insulating value. Note also if you can get access to the area where the insulation will have to be installed. If, for instance, a wall is closed on both sides with sheathing material, it is difficult to add insulation. However, if you have an attic space over a ceiling which is accessible, you can insulate the ceiling.
- 4. Check the building foundation to determine the floor exposure factor on page 3 of the Job Book.

 Put a check grank in the box opposite the foundation description which best describes the actual building foundation.
- 5. Check the condition of the home to determine the approximate infiltration rate. Put a check mark in the box under category 1, 2, or 3 which best describes the condition of each building component in the table page 2 of the Job Book. In order to select the appropriate category, check for the following:

Building Foundation

To determine leakage around sills and cellar windows, examine the structure from the inside. Look for "daylight" between the sill and the foundation. Feel for drafts at cellar windows. Push on windows to see if they are loose or rattle. Check for missing putty on sash. This detailed analysis will help decide if the cellar is in category 1, 2, or 3.

If the building is on posts, infiltration must be evaluated by an examination of the floor Open kitchen floor cabinets and look at pipe holes for the sink drain, etc. If these are tight, the building is category 1— open, category 3. Check the construction of the floor: if made of plywood or subfloor, paper, and finished floor, check category 1. If board floor with visible cracks and discernible drafts, check category 3.

Doors

Open the door quickly—A good fit will create a vacuum and resist the effort to open. A loose door will offer very little resistance. An on-hands—and—knees examination of the crack between the door and sill will also help. If twenty—five cent piece can be pushed under the door, check category 2, if two twenty—five cent pieces can be used, check category 3.

Windows

The same evaluation can be used on windows—push hard on the window—if a twenty-five cent piece can be pushed between the window and the casing, check category 2, if two can be used, check category 3.

<u>alls</u>W

To defermine infiltration through the walls, feel for deafts around outside wall electrical outlets. Check for caulking around doors and windows condition of paint, check for building paper.

The following are typical features of buildings with infiltration rates of approximately 1, 2, or 3 air changes per hour:

Building Component	One Air Change Per Hour	Two Air Changes Per Hour	Three Air Changes Per Hour
Building-with Cellar / OR	Tight, no cracks, caulked sills, sealed cellar win-dows, no grade entrance leaks	Some foundation cracks, no weatherstripping on cellar windows, grade entrance not tight	Stone foundation, considerable leakage area, poor seal around grade entrance
Building with crawl space or on posts	Plywood floor, no trap door leaks, no leaks around water, sewer and electrical openings	Tongue and groove board floor, reasonable fit on trap doors, around pipes, etc.	Board floor, loose fit around pipes, etc.
> Windows	Storm windows with good fit	No storm windows, good fit on regular windows	No storm windows, loose fit on regular windows
Doors	Good fit on storm doors	Loose storm doors, poor fit on inside door	No storm doors, loose fit on inside door
Walls	Caulked windows and doors building paper used under siding	Caulking in poor repair, building needs paint	No indication of building paper, evident cracks around door and window frame

Usually building components are not all in the same infiltration category. You can estimate the approximate rate by considering how many of the components are in each category. For example, it two components are in the three air change category and two are in the two air change category, the overall infiltration would be 2 1/2 air changes per hour.

- 6. Talk with the occupant of the house. Get his comments on the winterization problems and what he thinks can be done about them. Note his comments on page 1 of the Job Book. You may find more problems with the building by talking with the occupant than by looking at the house.
- 7. If you can, get answers to the questions on page 1A of the Job Book.
- 8. Before you leave, fill in the directions for locating the house, either by a map or description of how to get there on page 9 of the Job Book. This will help the person who is to do the work on the house.

HOME WINTERIZATION: STEP 2 - CALCULATION OF HEAT LOSSES

The next step in the home winterizing procedure is to calculate the heat losses expected from the house. Only simple calculations are necessary and you can do it away from the job site. By following the Job Book step by step, you can calculate the amount of heat lost in a given season from the building. To do this, you must determine the area of the exposed surface where the heat is lost; determine its insulation (R) value, select the district heating factor from the map on page 8 of the Manual, determine the infiltration rate from the table on page 2 of the Job Book, and from these figures you are able to calculate the heat loss from the building. On each of the pages of the Job Book, calculate the heat loss and the potential heat loss for infiltration losses, losses from windows and doors, floors, ceilings or roof, and walls and summarize these heat losses on page 8 of the center section in the Job Book. If you are unable to determine the construction of the exposed area and its heat loss, note that on the appropriate job sheet and also note it in the summary sheet. You are now ready to determine what winterization measures should be taken on the house.

HOME WINTERIZATION: STEP 3 - EVALUATION OF DATA

<u>Determining Winterization Measures</u>

In order to determine which winterization measures should be undertaken on the home, we need to consider several factors. By following the step-by-step procedure listed below, you should be able to determine the logical areas where winterization should be undertaken.

- 1. Check the heat unifs now required on the first column of the Summary Sheet, page 8 of the Job Book. Look for areas that have the highest heat requirement as logical areas for winterization.
- 2. Check the owner's comments on the bottom of page 1 of the Job Book. The following table may be helpful in determining what winterization measures are indicated from these comments.

Problem	Probable Cause	Remedy
Low house temperature High fuel usage	High heat-loss	Add Insulation Add storm doors and windows 1, Caulk and weatherstrip doors & windows
)		
Cold floors	Cold crawl space or basement	Add banking to increase craw! space or basement temperature
Drafty house	Loose doors and windows	Add storm doors and windows and caulk around windows and doors
Wet windows	Cold window surface or high humidity	Add storm windows or ventilate to reduce humidity
Wet walls or ceiling (uncommon complaint)	Cold inside surface or high humidity	Insulate wet surface or ventilate to reduce humidity.

- 3. All windows should be fitted with storm windows. Since this measure increases the insulation value of the window, as well as reducing the infiltration through windows, it usually results in the greatest benefit. Storm doors do not give as much benefit as storm windows.

 Weatherstripping exterior doors is nearly as effective as storm doors and not as expensive.
- 4. Check to see if insulation can be applied. If there is not at least 6 inches of insulation in the ceiling 3.1/2 inches in the sidewall, and 3.1/2 inches under the floor, if the basement or crawl space is unheated, consider adding insulation. It usually will result in a substantial heat saving. Check the Job Book to determine if insulation can be added to the areas where it is needed. It is usually easy to add insulation to an attic space and difficult to add insulation to a sheathed wall or below the floor.
- 5. Check to see if the floor exposure factor on page 3 of the Job Book, and infiltration from the foundation, page 2 of the Job Book, can be improved by adding banking materials. The procedure for adding banking materials is shown on page 14 of the Winterization Manual. If floor is over unheated area, consider insulating the floor. If over a crawl space, consider insulating the exposed foundation wall.



- 6. Check to see if weatherstripping can be installed around single doors and windows; or storm doors, to reduce the infiltration rate. Usually weatherstripping is not necessary if storm windows have been applied. This measure usually is not as effective in reducing heat loss as those listed above, but if for any reason you can't install storm doors and windows, make sure the weatherstripping is adequate.
- 7. Check to see if the infiltration through the wall can be reduced by caulking around doors and window frames. This is one of the less effective measures of reducing heat loss, however, it may help in a loosely constructed building.
- 8. You now should be able to determine where the most logical areas of winterization should occur. Fill in the proposed changes in the third column of the Summary Sheet on page 8 of the Job Book and calculate the heat savings from the proposed changes, using the procedure which was originally used in determining the heat requirements.
- 9. Check the availability and price of winterization materials in your area. Visit several of the building supply dealers and determine what kind of winterization materials are available and the price. It is a good idea is make a list of these, as you will be able to select which dealer has the proper materials available at the most attractive price.
- 10. Calculate the quantities of materials needed to complete the home winterization under item Number 5, page 8 of the Job Book.
- 11. Complete the job sheet on page 9 of the Job Book, listing the materials required and their cost, along with the instructions for applying the materials. This sheet is to go to the job site when the work is to be done and any instructions required for the installation of the materials should be made on this sheet.
- 12. Calculate the total cost of the winterization materials on page 10 of the Job Book, and calcutate the pay-off time for winterization materials.

Pages 13 through 22 of the manual show examples of using the Job Book. Follow these pages carefully until you become familiar with the procedure.

EXAMPLE OF COMPLETED JOB BOOK

Before proceeding to Step 4: Installation, the example of the completed Job Book (starting on the facing page) should be carefully reviewed until you are familiar with the procedure.

Instructions for completing the Job Book are given on each page of the Job Book. Explanation of the procedure to be followed will be found in this Manual on pages 9-12.



Federal Energy / Administration

Washington D.C.20461



PROJECT RETRO-TECH

Home

Winterization

Job Book *

for

Name: MARY PERKINS

Address: 3 PINE STREET

BANGOR, MAINE

WORK RECORD

ssignment

Supervisor

Date Completed

IOME EVALUATION:

Field Inspection (pg. 1-7)

ED. JONES

5-2-75

Heat Loss Calculation (pg. 8) P. SMITH

5-6-75

OB SHEET (pg. 9-10):

Order Materials Instali Materials E. HALL S. PAUL-

5- 10-75



Sketch all views and put dimensions on each part shown, e.g., length of walls, width and length of windows, etc. Label all single glass windows and double glass and doors . Complete all items in the Job Book labeled Fill in at Job Site."

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PAGE 1

•DESCRIPTION OF BUILDING (Continued from Opposite Page)

DWELLING UNIT INFORMATION	HEATING SYSTEM INFORMATION
NAME OF HEAD OF HOUSEHOLD	* TYPE OF FUEL: (P = Primary) (S = Secondary)
MARY PERKINS	P Fuel 0il Natural Gas
NAME & ADDRESS OF OWNER: (if not the same as above)	Bottled Gas S Wood &
MARY PERKINS	Coal/Cobe Kerosene
3 PINE STREET	Electricity Other (Specify)
BANGOR, MAINE	
	* TYPE OF HEATING SYSTEM: (P = Primary) (S = Secondary)
OCCUPANTS OF STRUCTURE:	
Total Number	P Steam/Hot water/Hot Air
	S Fireplace/Stove/Portable Heater
STYLE OF STRUCTURE:	Electrical Baseboard
One Story Split-level	
Two Story Other	Other (Specify)
(Specify)	
2 1/2 Story .	
	The Domestic Hot Water:
AGE OF STRUCTURE (Approx): 10 years	Does central heating system provide heat for domestic hot water?
ROOMS IN LIVING SPACE:	
Total Number of Rooms6	# THERMOSTAT SETTING IN WINTER (average):
Number Used in Winter6	Day 65 Night 60 None
OCCUPANTS COMMENTS (e.g., drafty, cold	* AMOUNT OF FUEL USED LAST HEATING SEASON:
floors, too expensive to heat, etc.):	Primary Supplementary
FUEL BILLS TOO HIGH	Type FUEL OIL " WOOD
	Quantity 1500GAL. 1 CORD
DRAFTY WINDOWS	Fotal Cost \$585.00 \$ 45.00
	rotal cost 5003.
	# DISTRICT HEATING FACTOR
OLC:	PAGE 1A
Name of the last o	130

On pages 2 thru 7, can make hea separate parts of the building, and the heat loss by Infiltration and by Conduction thru the ng, and enter the results in the table at the bottom of each page, and in the Summary Table on page 8. HEAT LOSS BY INFILTRATION Volume of Air. HOUSE DRAFT INDEX: Opposite each of the four component parts of a building in the table below, place a check mark in the circle adjacent to the in building features which best describe the condition of the building. Floor Area BUILDING ONE TWO THREE Œ COMPONENT 2 Air Change Air Change Air Change Per Hour Per Hour Per Hour CELLAR Tight, no cracks, Some foundation Stone foundation, caulked sills, cracks, no weather considerable sealed cellar stripping on leakage area, poor or windows; no grade cellar windows, seal around entrance leaks grade entrañce not tight grade entrance CRAWL Plywood floor, trap door leaks, Tongue and groove Board floor, loose SPACE board floor, reasonable fit on fit around pipes. no leaks around etc. water, sewer and trap doors, around electricals pipes, etc. openings Storm windows WINDOWS No storm windows, good fit on No storm windows. with good in loose fit on regular windows regular windows DOORS Good fit on Height to ceil-Loose storm doors, poor fit on No storm doors ing (to upstairs storm doors loose fit on inside door ceiling in twoinside door story house) WALLS Caulked windows Caulking in poor repair, building needs paint No indication of and doors, building paper, building paper evident cracks used under around door and siding window frame MULTIPLY the number of check marks in the first column by 1, the second column by 2, and the third column by 3. The Draft Index will be the sum of these products, divided by 4. District Heating Heating Units Factor Now Required Potential Savings by Reducing Infiltration It should be possible to reduce the draft index for a building to 1 (that is reduce the number of air changes to one per hour). If the draft index for this building was improved to 1, the infiltration loss would be: District Heating Draft Index (from above) # Factor . Subtract the potential heating units from those now required and enter here HEATING POTENTIAL HEATING UNITS **HEATING** UNITS TO TYPE OF HEAT LOSS REQUIRED **SAVINGS** PROPOSED CHANGES TO STRUCTURE BE SAVED INFILTRATION 236

SITE

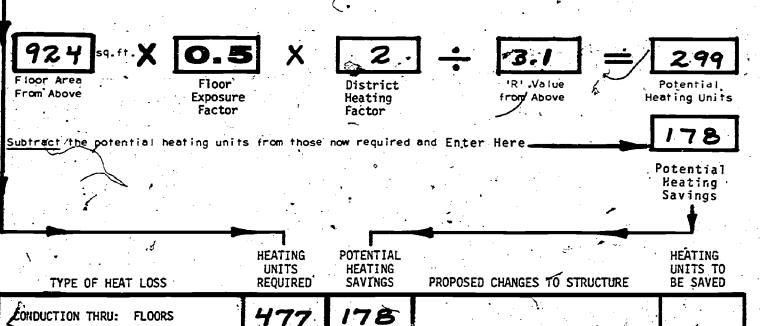
805

A

Floor Exposure Factor 'R' Value of Floor List below all materials in floor deck, including carpet but Select the appropriate factor from neglecting floor joists, starting from inside surface and workthe descriptions below: ing down. Building on posts or pillars with no skirts below floor insert 'R' value for each component from Table I 1.0 Crawl space skirted 0.8 Material Thickness 'R' Value Rock wall basement 0.8 Interior Surface .68 LINOLEUM More than two feet of base-08 ment wall exposed above 1/2" <u>Plywood</u> . 65 grade 0.8 5/B' SUB-FLOOP 1.00 ☐ Building on sl**a**b 0.5 Building with tight crawl space 0.5 Building with tight base-ment (heated or unheated) 0.5 Interior Surface .68 Floor Area District Total Heating Units Floor (from Build-Exposure Factor Heating 🤾 'R' Value Required ing Descrip-Factor tion)

<u>Potential, Savings on Floor Heat Losses</u>

Floors can sometimes be insulated to reduce heat loss but thes is often difficult, and where water pipes are below the floor may cause freezing problems during very cold spells. However, every floor should be protected from drafts, etc., so that it has a floor exposure factor of 0.5. With this exposure factor for this building, the heat loss through the floor welld be:



EDIC



Area of Ceiling

(Take area of upstairs ceiling in a two-story house)

Ceiling area will normally be the same as floor area (from building description sheet)

Material	Thickness	s 'R' Value
Inside Surface		.68
GYPSUM BOARD	3/8"	.32
FIBERGLASS	2"	7.40
		. (
	او د	
		• .
		,
Inside Surface (.68)		.68
Outside Surface (.17)		

Distance between joists/rafters:

16"

924 s

2

District Heating Factor 9.1

Total 'R' Value 203

Heating Units Required

Potential Savings by Insulation of Ceilings

A well insulated ceiling (with 6 inches of insulation) should have an 'R' value of 20. If this was so top this building, the ceiling heat loss would be:

924 sq.ft.

Ceiling Area

2

District Heating Factor •

- 20

'R' Value

Potential Heating Units

110

Subtract the potential heating units from those now required and Enter Here.

Potential Heating Savings

TYPE OF HEAT LOSS

HEATING UNITS REQUIRED

POTENTIAL HEATING SAVINGS

PROPOSED CHANGES TO STRUCTURE

HEATING UNITS TO-BE SAVED

CONDUCTION THRU: CEILINGS,

203 | 110

PAGE 4

133

ERIC Full Text Provided by ERIC

Area of Single Glass Windows: If none, enter 0 and go to next sheet on double windows and .Width x Height x·Number = Area TOTAL District Heating Units Required Heating Factor Potential Saving by Double Clazing Double glazi: g or adding storm windows will cut The heat loss by half, so divide theating units by two, and Enter Here. Potential Heating Savings **HEATING POTENTIAL** HEATING UNITS TO BE SAVED UNITS **HEATING** PROPOSED CHANGES TO STRUCTURE REQUIRED SAVINGS . TYPE OF HEAT LOSS CONDUCTION THRU: SINGLE-GLASS WINDOWS 136 68 PAGE 5

ERIC

HEAT LOSSES BY CONDUCTION THROUGH DOUBLE GLASS OR PLASTIC COVERED WINDOWS AND THROUGH DOORS

(Assuming R = 2 for these units)

Area	Of	Doub la	Glass	and Doors	_

Width		× Number	= Area
3	7	2	42
6	4	1	24
3	4	2	24
		•	*
,)	•	**	
-) - '	` .		

TOTAL 90 sq.ft X 2 = 90

District Required Required

Potential Savings

Triple glazing of windows can be done but is not usually practical. If no change is made in the windows, the Potential Saying will be 0 heating units and should be entered here

(If windows are triple glazed; the "R" value will be approx. 3 and the Potential Savings will be one-third of the "Heating Unit's Required.")

Potential Heating Savings

HEATING POTENTIAL

UNITS HEATING
UNITS TO
REQUIRED SAVINGS PROPOSED CHANGES TO STRUCTURE BE SAVED

CONDUCTION THRU: DOORS & DOUBLE-GLASS WINDOWS

90 0

PAGE 6

EXAMENT LOSSES BY CONDUCTION THROUGH WALLS

Total Perimeter		'R' Value of Outside V	Nalle Nalle	•	
	22	List below all material including air spaces weach component from To	als in walls	, starting fr all. Insert	om inside and 'R' value for
	X	•		Ŕ,	
Total Height of Outside Wall	8	Material	Thickness	Value .68	
		CHASIDE SUFFACE	3/0."	.32	
		AIR SPACE	3/4"	.91	
Gross Wall Area 9	76 sq.ft,		2"	7.40	•
		AIR SPACE	3/4"	.41	• `
Total Area of all		SHEATHING	5/B"	1.00	
Windows and Doors (from previous	58 sq.ft.	ASBESTOS SHIM	GES 1/4"	.13	
two pages)		Outside surface		.17.	・
Net Wall Area	18 sq. ft.	× Z	÷ [11.6	= 148
•		District Heating Factor	• 🕊	Tota: 'R' Value	Heating in is Required
Potential Sovings by Ins	<u>u latio</u> n			-	
Well insulated walls sho		value of 15. If this	was so for	nis building,	, the wall heat 🦠
loss would be:	,~•.				
81	8 ~		<u> </u>	15 =	= 109
	II Area	District Heating	• •	"R' Value	Potentia:
d. Afrom bo		Tactor	•		Heating units
Subtract the potential b	eating units fro	ir m those now required a	nd Enter H	ere .	39
<u></u>		•		`o	
			:		Potential Heating:
					Savings
		•	•		; ,
	\ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \		:	<u> </u>	
		•			
	HEATING	POTENTIAL			UEATANG .
TYPE OF HEAT LOSS	HEATING UNITS	POTENTIAL HEATING	D CUANCES TO) crnucrate	HEATING : UNITS TO
TYPE OF HEAT LOSS	REQUIRED		D CHANGES TO	Y STRUCTORE	BE SAVED
CONDUCTION THRU: WALLS	148	39			

Page

- Use the instructions on page 11 of the FEA Winterization Manual to assess which potential savings can be obtained post successfully.
- Fill out the following Summary Table by entering the "Heating Units Required" and the "Potential Heating Savings" from the corresponding tables at the bottom of pages 2 through 7. Then, write in the "Proposed Changes" and "Heating Units to be Saved" by such changes.

HEAT REQUIREMENT ESTIMATES (Annual Heating Units Needed)

тот	ALS	1580	631		592
CONDUCTION THRU:	Page 7	142	39	NONE - WALLS CLOSED	0
CONDUCTION THRU: DOORS & DOUBLE-GLASS WINDOWS	Page 6	90	0	NONE	0
CONDUCTION THRU: SINGLE-GLASS WINDOWS	Page 5	136	68	ADD PLASTIC STORM WINDOW	68
CONDUCTION THRU: CEILINGS	Page 4	203	110	ADD 4" INSULATION	110
CONDUCTION THRU: FLOORS	Page 3	477	178	CAULK BASEMENT BANK WALL	178
INFILTRATION .	From Page 2	532	236	ALL DOORS & WINDOWS	236
TYPE OF HEAT LOSS		HEATING UNITS REQUIRED	POTENTIAL HEATING SAVINGS	PROPOSED CHANGES TO STRUCTURE	HEATING UNITS TO BE SAVED

Use the space below to calculate the quantities and cost of materials needed to make the proposed changes to the building.

INSULATION

CEILING - 924 - H- ORDER 1000 m. ft.

PLASTIC STORM WINDOWS

5 WIDE PERSTIC

4 4 3 = 12'

1 × 5' = 5' ORDER 20' + TAPE

BANKING

4 wipe PLASTIC

33 + 28 + 33' = 94 - • RPER 100' + TAPE

WEATHERSTRIP

2 DOORS - 7x3' 17'FACH x2'34' ORDER 35'

CAULK

AROUND & WINDOWS & 2 DOORS = 122' + BASEMENT - ORDER 5 TUBES

6 Fill in job sheet on opposite page.

THIS PAGE IS REMOVABLE FOR USE AT JOB SITE

Name MARY PERKINS

Address 3 PINE STREET BANGOR ME

Type of Materials	Quantity Required ,	Estimated Cost	Location Where Materials Are To Be Installed (Walls, Ceiling, etc.)	Instatiation Diagram No.	Special Instructions
4° insuca) 000 Sec.	70.00	CEILINO	I-3/	TAME SHEAD
POLYSTANCE		16.00	BANKING	B-1	
Poly. 4mm 5'was	20FT.	4.00	WINDOWS	P-1	NEED KHIFE
2" MARKIN TAPE	3 Roces	6.00	BANKING & WINDOWS	B-1 ? P-1	
COMPOUND	6 Toba	6.00	WINDOW & POOR FRAMES	C-1	NOSD CAULKING
NEATHER Star VMYL	35 <i>F</i> -	3.∞	Doors	5-2 \$ 5-4	NEED HAMMER
10 10 10 10 10 10 10 10 10 10 10 10 10 1					
	(INS	ERT CARBO	N PAPER UNDER TABLE AT TOP OF PA	GE ONLY)	

Map or directions for locating holle:

ROUTE 222 FROM CENTER OF TOWN 1.5 MILES

FIRST HOUSE ON LEFT AFTER CROSSING BRIDGE

WORK RECORD

Activity
Order Materials
Install Materials

Supervisor E.Hall Oll Mitrick Ordered Door not Weatherstiged

PAGE 9

138

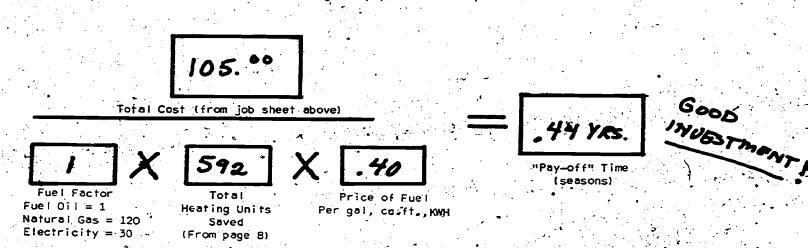
FILL IN AT JOB SITE

JOB SHEET B THIS PAGE IS RETAINED WITH JOB BOOK AS PERMANENT RECORD

Type of Materials	Quantity > Required	Estimated Cost	Location Where Materials Are To Be Installed (Walls, Ceiling, Etg.)	Installation Giagram No.	Special Instructions
4"INSULATE	1000 5097	70.00	CEILING	I•3.	TAKE SHEARS
Personal and Sold	100 8	16.00	8 ANKING	8-1	
S'wing	20 Fr	4.00	WIN POWS	P-1	NESS KNIFE STAPLER
TAPE	3 Rous	6.00	BANKING & WINDOWS	B-1 (P-1	
AULKING OMPOUND	6 Tubes	6.00	WINDOW & DOOR FRAMES	C-/ S-2 & J-4	NEED CAUKING
PERTHER TRE YINYL VBIMO	355	3.00	Poors		NESD Hama
	Total Cost	105.00			

PAY-OFF TIME

This is the number of seasons for fuel savings to pay off the cost of winterization..



ERIC

PAGE 10

139

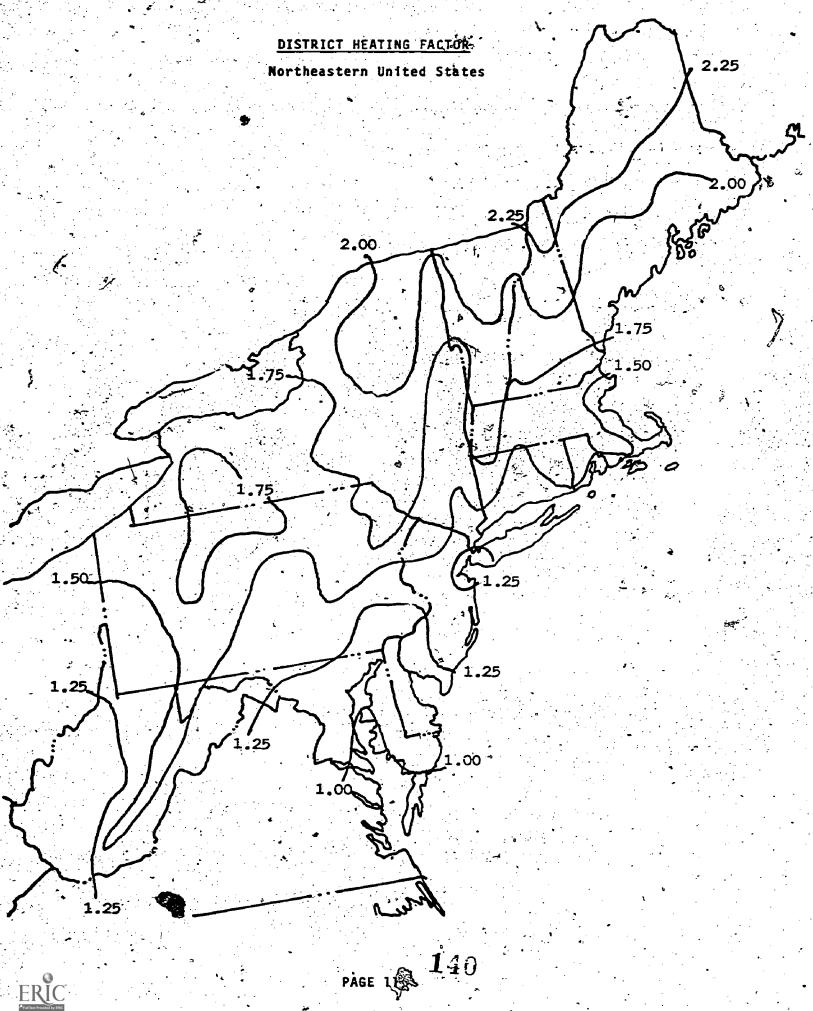


TABLE I. INSULATION VALUE OF COMMON MATERIALS

Source: ASHRAE Guide and Data Book

MATERIAL THICKNESS	"R' VALUE
Air Film and Spaces	
Air space, bounded by ordinary materials 3/4" or mor Air Space, bounded by aluminum foil 3/4" or mor	
Exterior surface resistance	0.17 0.68
Masonry	
Sand and gravel concrete block 8" Sand and gravel concrete block 12" Lightweight concrete block 8"	1.11 1.28 2.00
Lightweight concrete block 12" Face brick 4" Concrete cast in place 8"	2.13 0.44 0.64
Building Materials - General	48
Wood sheathing or subfloor. Fiber board insulating sheathing 3/4" - Plywood 5/8"	1.00 2.10 0.79
Plywood Plywood 3/8" Bevel lapped siding - 1/2" x 8"	0.63 0.47 0.81
Bevel lapped siding 3/4" x 10" Vertical tongue and groove board 3/4" Drop siding 3/4"	1.05 1.00 0.94
Asbestos board 1/4"' 3/8" gypsum lath and 3/8" plaster 3/4"- Gypsum board 3/8"	0.13 c 6 0.42 0.32
Interior plywood panel Building paper Vapor barrier	0.31 0.06 0.00
Wood shingles Asphalt shingles Linoleum	0.87 0.44 0.08
Carpet with fiber pad Hardwood floor	2.08 0.71
Insulation Materials (mineral wool, glass wool, wood wool, etc	<u>)</u>
Blanket or batts Blanket or batts 3 1/2" Blanket or batts 6"	3.70 11.00 19.00
Loose fill Rigid insulation board (sheathing) 1" 3/4"	3.33- 2.10
Windows and Doors	
Single window Double window Exterior door	Approx. 1.00 Approx. 2.00 Approx. 2.00



HOME WINTERIZATION: STEP 4 - INSTALLATION OF MATERIALS

Before attempting to apply winterization materials, make sure that you have the right material for the job and the proper equipment for installation. Ladders, step ladders, hammers, staplers, caulking guns, putty knives, utility knives, measuring tapes, saws and shears are needed to apply winterization materials. Determine what needs to be done in applying the material and make sure the equipment is available.

Storm Windows and Doors

How you install plastic over windows and doors depends upon the type of plastic you are installing.. Polyethylene film will last only one year so it, is not necessary to apply the material on an elaborate framing since it will be removed after one year. Viny! film, on the other hand, will last several years and probably can best be used by building light frames, either for the door or window, and installing the plastic over the frames. For installing polyethylene film, cut the film to the desired size and apply over the window frame, using laths and nails, staples, or tape, as shown in figures P-1 and P-2. Tape is generally satisfactory for one year and does not leave holes in the framing members. Before applying tape over windows and door frames, make sure that they are clean and free from flaking paint. Masking tape or plastic tape is generally satisfactory for applying polyethylene over windows and door frames. Light frames for applying clear vinyl can be made out of 1" x 2" strapping, joining the corners either with a half lap joint or corrugated fasteners and applying the plastic over the frame with lath and nails. See pages 22-25 for stepby step instructions.

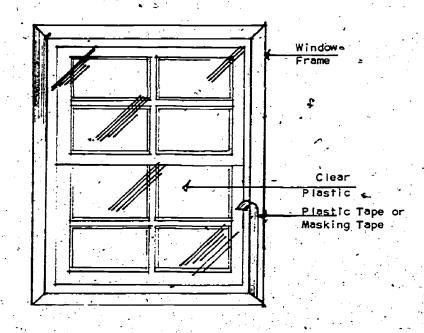


Figure P-1 PLASTIC STORM WINDOW USING TAPE

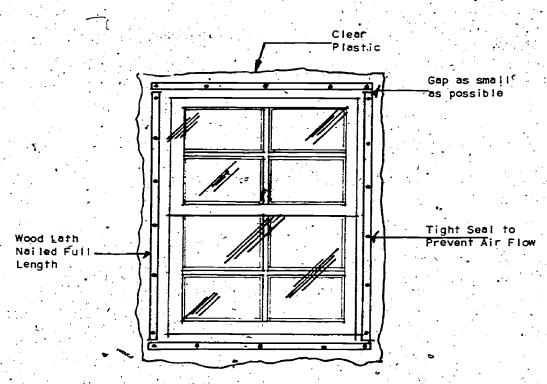


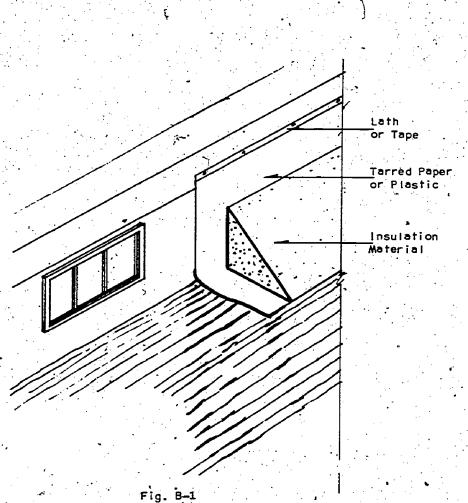
Figure P-2 PLASTIC STORM WINDOW USING LATH AND NAILS



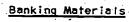
Caulking

Caulking compound is available in eleven ounce cartridges, in bulk, for use in caulking guns, or preformed into a rope or cord for application by hand. Caulking compound ordinarily is of the oil base type. However, it is available in latex or but rubber base. The rubber base caulking compounds remain flexible and will not dry out, and are particularly useful where surfaces will move in relation to each other. Do not use caulking compound between surfaces that are to be moved, such as the window sash and window frame. Use weatherstripping in areas where one surface has to be moved. The preformed type of caulking compound is more fibrous and easier to use in filling large openings.

Apply caulking compound only during warm weather. The temperature should be above 40 degrees and the materials should be kept warm to be workable. The surfaces should be clean and dry, free from flaking paint and loose dirt. Force the caulking material into the crack or opening and smooth out the material, either with your hand or a putty knife. On bare wood, the material aladheres better if you prime the material with linseed oil or paint. Do not attempt to apply caulking compound during cold weather since the material will become stiff and difficult to work.



SHOWING INSTALLATION OF BANKING MATERIALS



When banking house foundations, the most important material is the paper or plastic to keep out the air infiltration into the space below the floor. Usually three foot wide material is sufficient to reach from the siding to the ground level. Unroll the material around the side of the house, allowing it to lap down on the ground at least one foot. . Polyethylene film or tarred paper is satisfactory for this type of banking material. Fasten the material to the sidewall of the shouse, using laths and nails or tape. Tarred paper is usually applied with laths and nails. Plastic can be applied either with laths and nails or tape. Some types of siding material, such as cement asbestos siding, aluminum or vinyl siding, nails and laths cannot be used. Masking tape or plastic tape can be used to fasten the banking material to the siding.

Fig. C-1

CAULKING WINDOW FRAMES

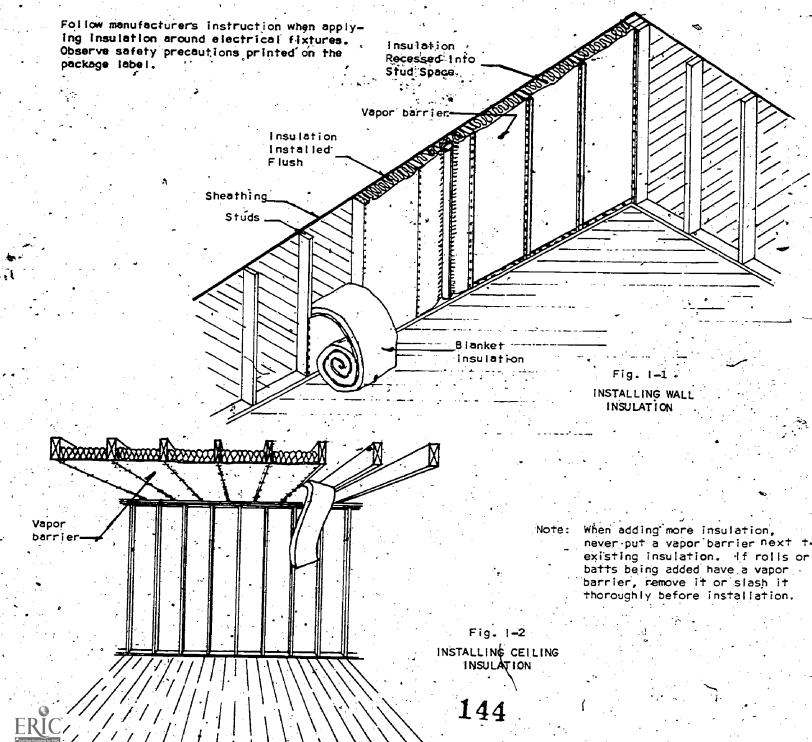
If insulating material is to be added to the foundation, pile the insulating material in the corner between the foundation and the ground line. If sawdust, shavings; or hay is used, it is usually a good idea to cover the material with plastic after it is applied to keep it from getting wet. Boards or 2 x 4's can be used to lay over the plastic to keep it in place. The banking material should be removed in the spring to allow the siding and framing of the house to dry out since moisture tends to collect behind the plastic or tarred paper.



Applying Insulation

In applying blanket type of insulation, cut the blanket or batt to a length to fit the opening where it is to be installed. If the blanket has a vapor partier, be sure to apply the vapor barrier on the warm side of the insulation. If two pieces of insulation are to be joined in the framing space, make sure the joint is tight to prevent air leakage. Fit the blanket insulation into the framing space and staple in place. If the vapor barrier is of the kraft type, staple the vapor barrier flush with the face of the framing member as shown in Figure I-1. If the vapor barrier is of the aluminum foil type, recess the insulation into the framing space and staple into the sides of the framing members. Do not use insulation with a vapor barrier when re-insulating over an already insulated area. Insulation without a vapor barrier is available for this type of installation. Blanket insulation with kraft vapor barrier is usually the most economical.

When installing loose fill insulation, pour the material onto the surface or into the wall cavity until the area is full. If you are pouring into a vertical wall, settle the material with a piece of strapping or broom handle to make sure that no voids are in the insulation. Be careful not to allow voids to form below windows, doors, or fire stops. Leave access to vertical wall spaces so that the insulation can be refilled after it settles. When installing fill type insulation onto ceiling areas, pour the insulation onto the top of the framing members and level with a rake or board to the desired thickness.



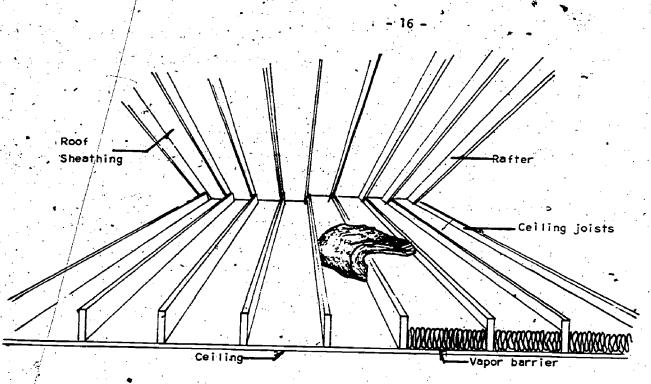
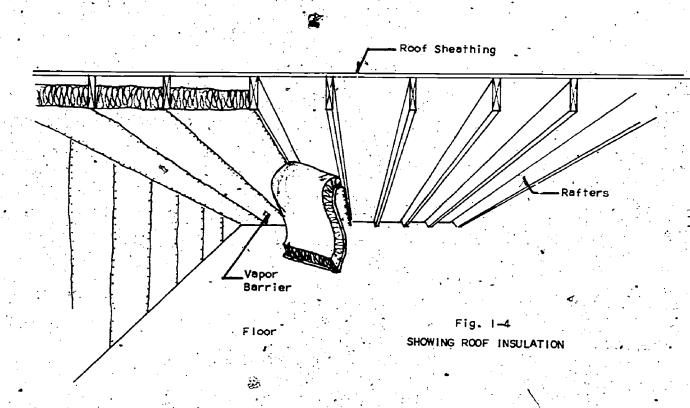


Fig. 1-3 INSULATING CEILING FROM ATTIC



WEATHERSTRIPP ING

Weatherstripping materials vary considerably, depending on the type of material and location it is to be used.

The illustrations listed below describe the application of most commonly available materials and their relative ease of use.

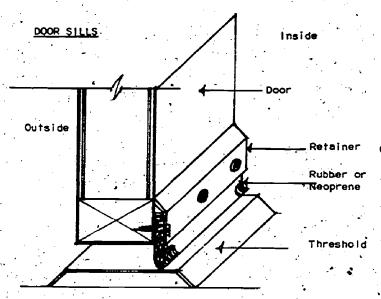


Fig. S-1

Rubber or neoprene strips seal the bottom of the door, and can be installed without removing the door. This seal can also be fashioned from the heavy rubber weatherstripping used to seal around overhead garage doors or can be cut from a truck tire flap. These heavy rubber seals can be nailed directly to the door without using a retainer.

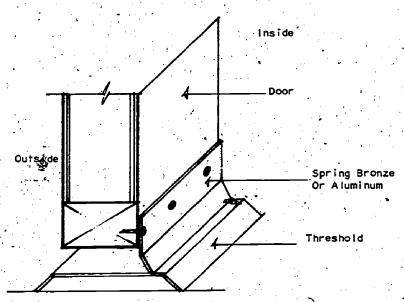


Fig. \$-3

Metal strips are spring bronze, aluminum and stainless steel. In general, this type is less satisfactory and more expensive than S-2 (doors must be removed for installation and made parallel with sill; metal may scratch floor).

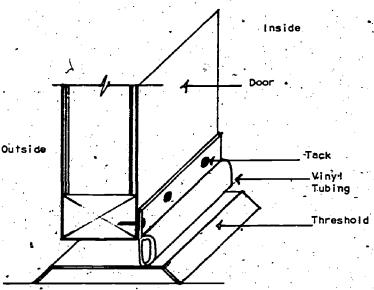


Fig. S-2

Viny! tubing also allows installation without removing the door. The tubing can be bought hollow or with foam rubber in the cavity, and can be tacked or stapled to the door.

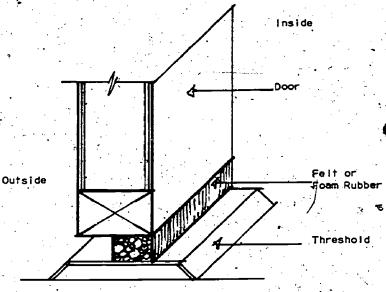
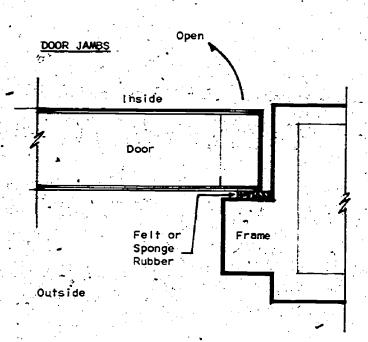


Fig. S-4

Felt or foam rubber strip may be attached to the bottom of the door. The strip can be tacked or stapled. Foam rubber strips can also be bought with self-stick backing. While this may be the cheapest material, it requires removal of the door.





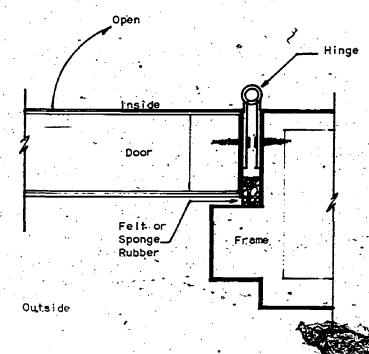


Fig. J-1

Fig. J-2

Felt or foam rubber can be glued, stapled or tacked to the door frame. Door removal is not required.

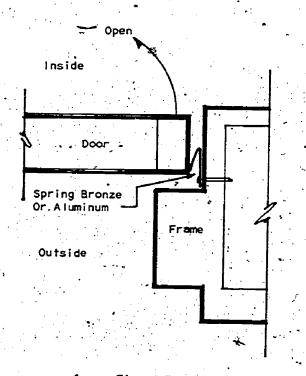


Fig. J-3

A spring metal clip may be more expensive than the solutions in J-1 and J-2, but the metal won't tear like the foam rubber will. If possible the weatherstripping should be applied so that the air flow tends to make the seal tighter. The air flows through the crack from the bottom of the figure to the top and forces the metal ast the door.

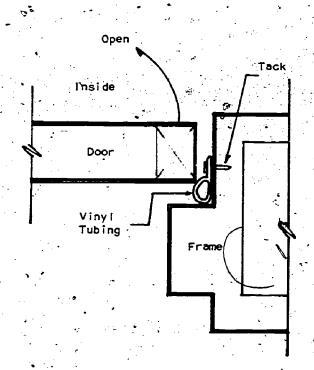


Fig. J-4

Vinyl tubing can be either tacked or stapled to the door frame. This is almost as inexpensive as the felt shown in Figures J=1 and J=2.

Open
Inside
Frame
Sponge Plastic
and Retainer

Door

Plastic neoprene or felt and retainer similar to that of Fig. S-1 may also be used. A retainer can be a strip of wood.

Fig. J-5

WINDOWS

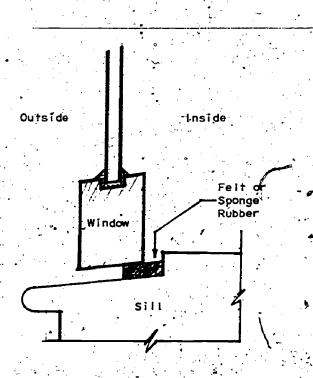
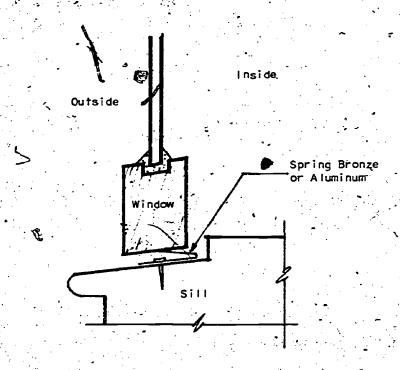


Fig. W-1

Felt or sponge rubber can be stapled, tacked, or glued to a window sill.





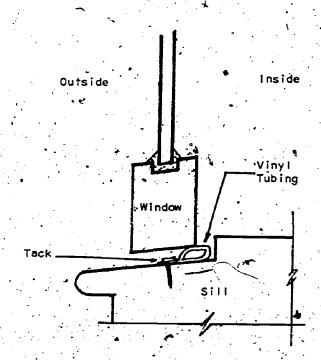
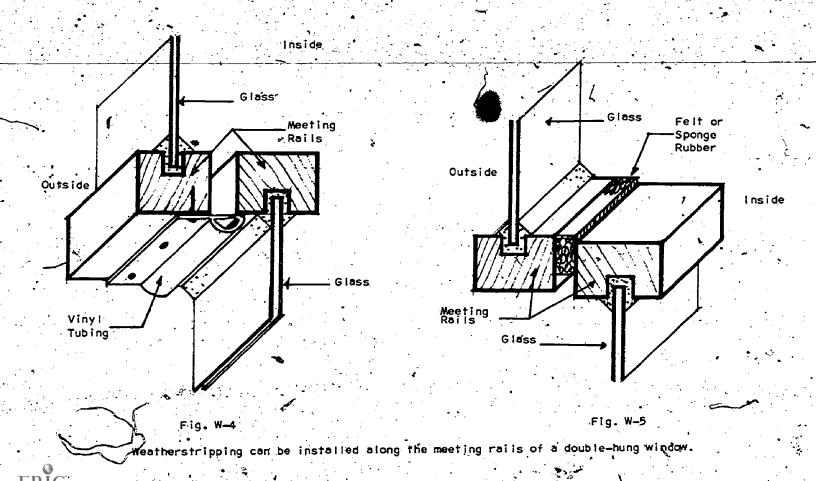
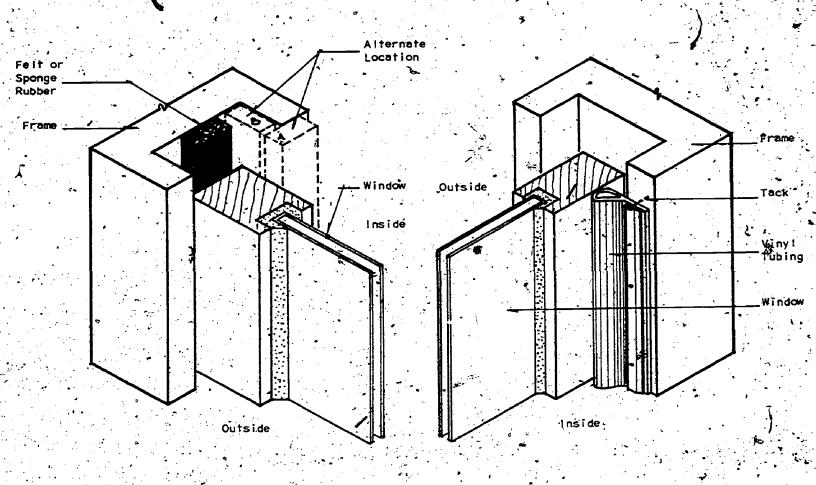


Fig. W-3

Vinyl tubing and spring metal can be installed. A cold draft coming in from the outside makes the seal tighter.





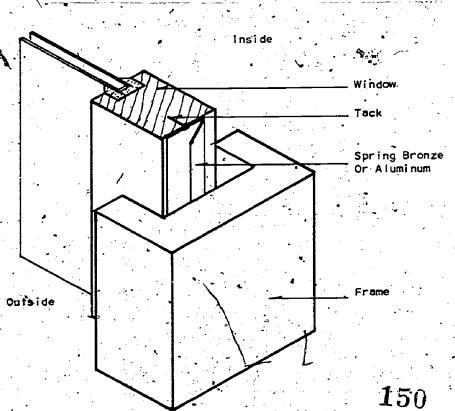


Fig. W-8

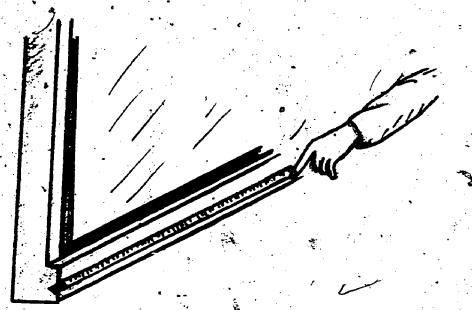
∘Fig. W-6

Fig. W-7 and alternate location A in Fig. W-6 do not require removal of the window. The metal strip shown in Fig. W-8 is expensive and requires removing the window.

Fig. W-7

.

HOW TO MAKE PLASTIC STORM WINDOWS



Step 1. Measure the area to be covered—length and width. Write this down or you will forget it.

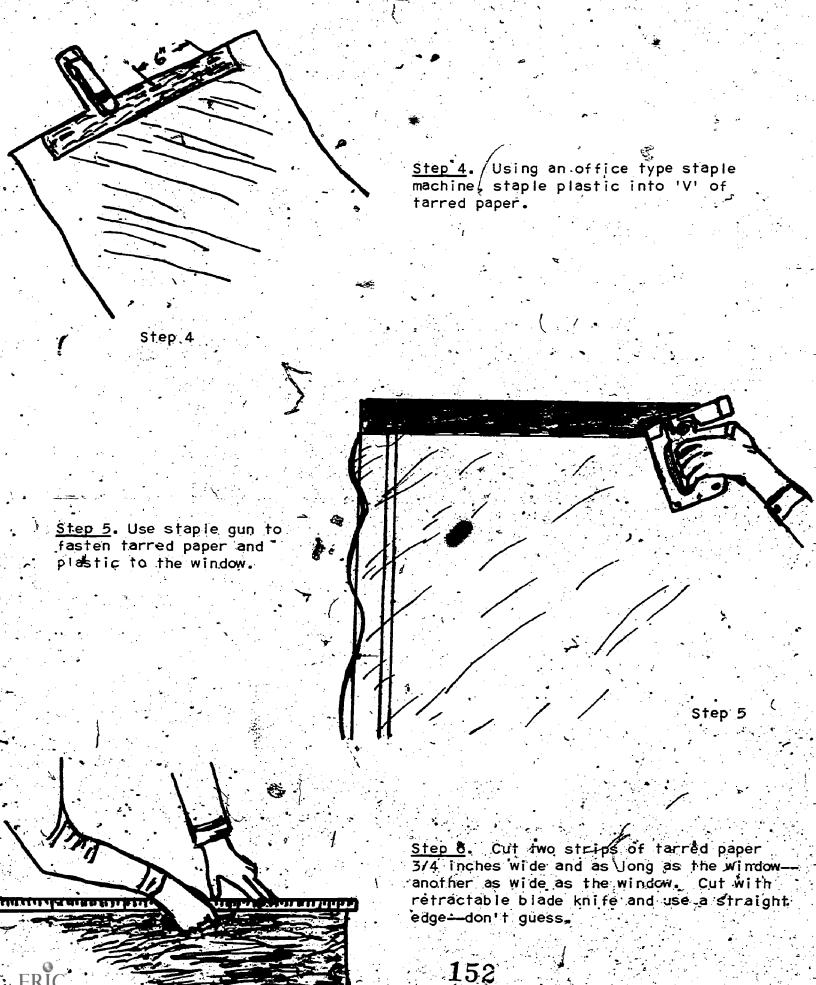
Step 1

Step 2. Cut a piece of tarred paper two inches, wide and as long as the window. Fold into 'V'.

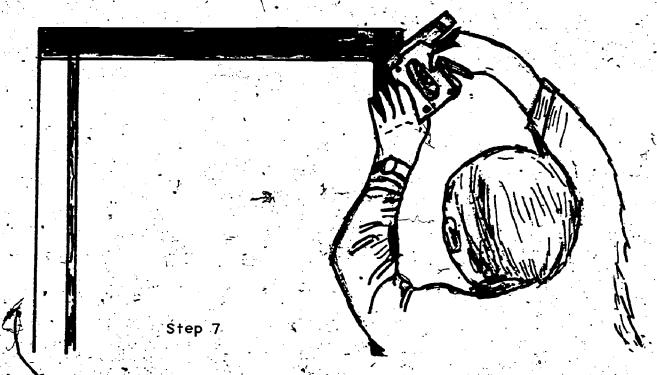


4" wider than window

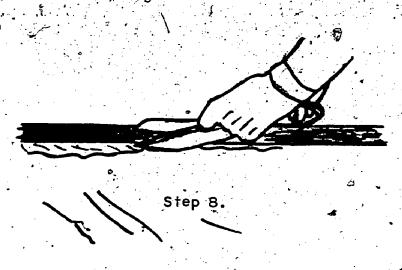
Step.3. Cut a piece of plastic four inches wider than the window and as long as the plastic is wide. The part left over will be used on another window. Keep cutting plastic as square as possible—there will be less waste this way.



Step 6



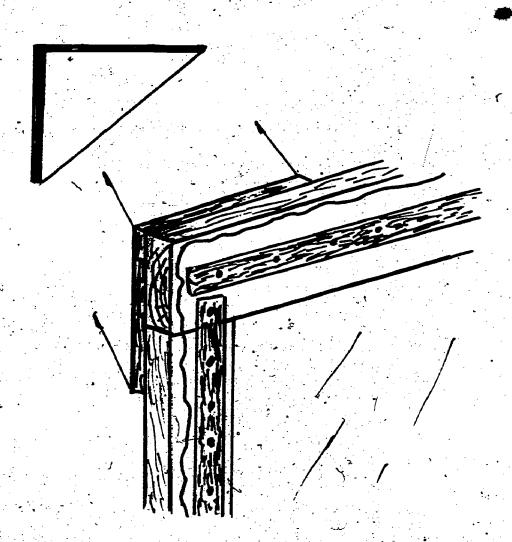
Step 7: Start at the top and tork down stapling the plastic (double back for two thicknesses) to the window through the strips of tarred paper. Staples every six inches in windy locations are plenty. Pull as much of the sag out of the plastic as possible as you go.



Step 8: Traim off the excess plastic.

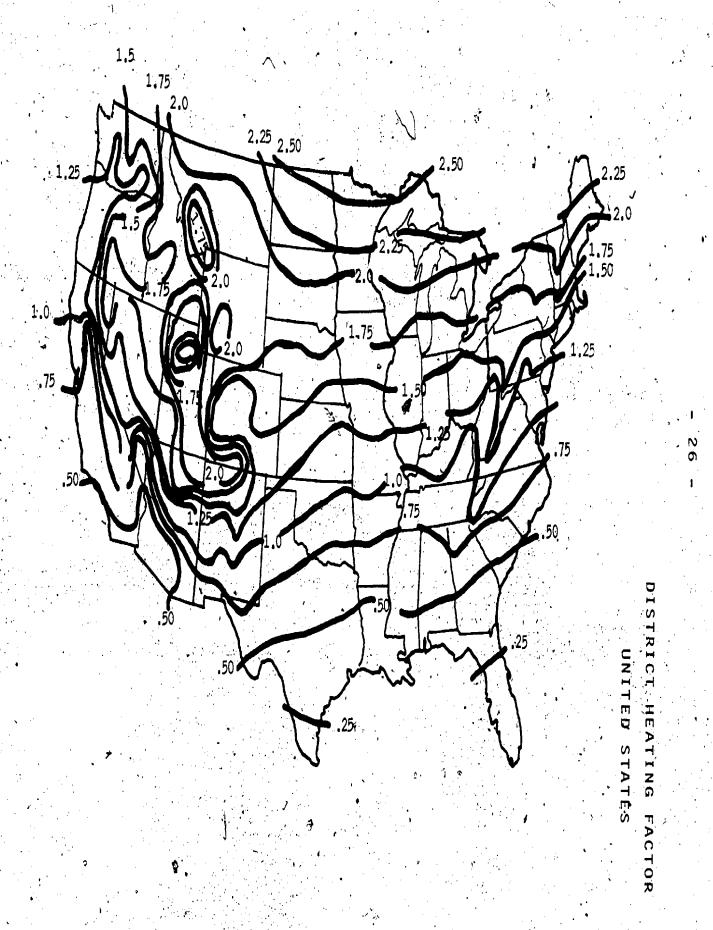
At the end of the season the staples can be removed and the plastic stored by rolling on the V' shaped tarred paper header. Six-year life for one sheet of 4 mil plastic is possible. The disadvantage of this system is the damage done by all the staples to the window trim.





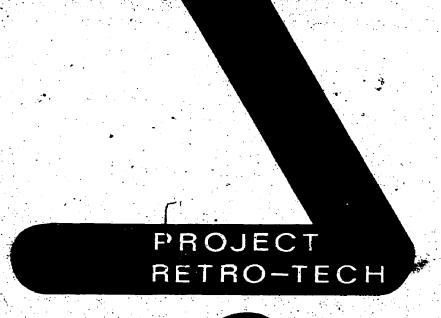
A second method would be to make a simple wood frame from lath (1" wide x 3/8" thick) Staple the plastic to it (the tarred paper strip is a good idea); then use four 2 penny hails to hold this to the window frame. This system is a liftle more difficult to make and store, but does less damage to the building.





ERIC Full East Provided by ERIC

	TYPICAL	COST OF	MATERI.	ALS	
Material	Type	Unit Size	Unit Cost	Local (Vendor	Date
Mineral Wool	16" Batt	8 ft.			
11 11	Loose	Cu. ft.			
		*			
Storm Window	Glass		1		
	Plastic film				•
Weatherstrip					
Caulking					₹
Strapping					
	•				
· Heating Oil		Ga1			
Electricity		кин	•		
Natural Gas		Cu, ft.			
Bottled Gas				fto.	
À Kerosene		Ga1			
Coal/Coke		Ton			
o o d		Cord	157.		



Federal Energy Administration Washington D.C. 20461



Hon	ne	
	teriz(aggion
والمراجع والمعاجب	Boo	k
for Name:		

WORK RECORD

Address:

Assignment	Supervisor	Date Completed
HOME EVALUATION:		
Field Inspection (pg. 1-7)	<u>* </u>	<u> </u>
Heat Loss Calculation (pg. 8)		
JOB SHEET (pg. 9-10):		
Order Materials		
Install Materials	<u> </u>	. <u> </u>

ERIC Full Text Provided by ERIC

JUNE 1975

DESCRIPTION OF BUILDING

Sketch all views and put dimensions on each part chown, e.g., length of wells, width and length of windows, etc. Label all single glass windows (5) and double glass and doors (0). Complete all items in the Job Book labeled "Fill in at Job Site."

F	ront	t V	'iew		1		1		1 .		1.	•	Rio	ht Si	đe Vi	ew					ļ ·		
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PAGE 1

FILL IN AT JOB SITE

<u>_DESCRIPTI</u>	ON O	F BUILDING	3
Continued	from	Opposite	Page)

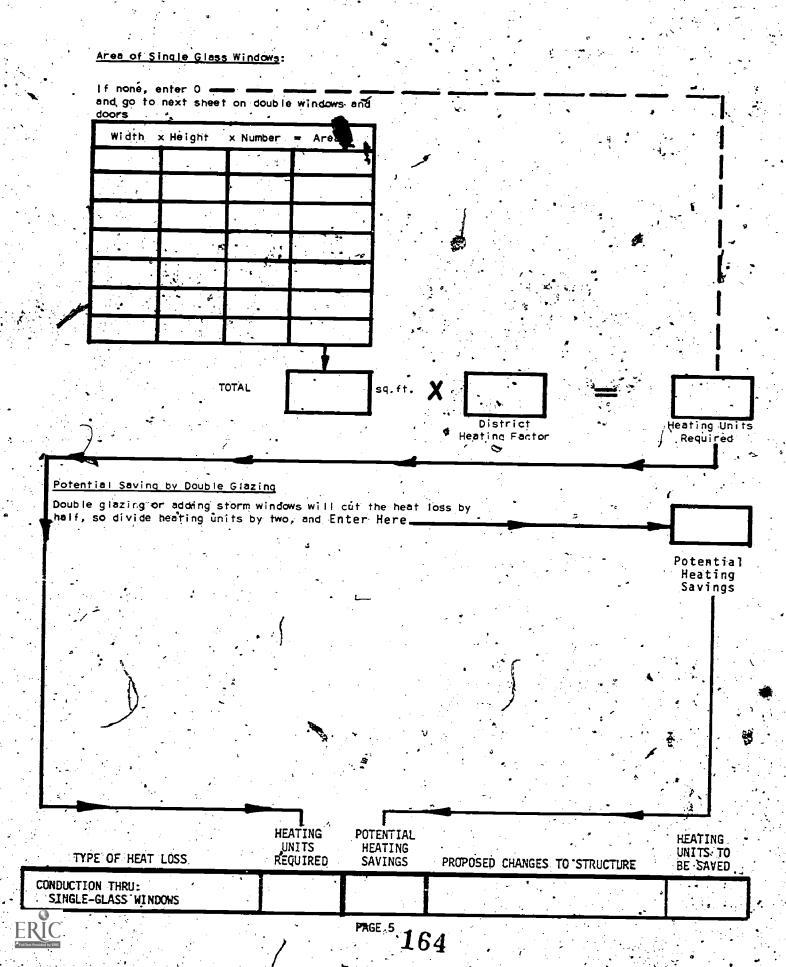
DWELLING UNIT INFORMATION	HEATING SYSTEM INFORMATION
NAME OF HEAD OF HOUSEHOLD	* TYPE OF FUEL: (P = Primary) (S = Secondary)
<u>*************************************</u>	Fuel Oil Natural Gas
NAME & ADDRESS OF OWNER: (if not the same as above)	Bottled Gas Wood
	Coal/Coke Kerosene
	Electricity Other (Specify)
CCUPANTS OF STRUCTURE:	★ TYPE OF HEATING SYSTEM: (P = Primary) (S = Secondary)
Total Number	Steam/Hot water/Hot Air
TYLE OF STRUCTURE:	Fireplace/Stove/Portable Heater
- One Story - Split-level:	Electrical Baseboard
Two Story Other (Specify)	Other (Specify)
2 1/2 Story	
CE OF STOUCTURE (Array)	TOMESTIC HOT WATER:
GE OF STRUCTURE (Approx): years	Does central heating system provide heat for domestic hot water?
DOMS IN LIVING SPACE:	
Total Number of Rooms	* THERMOSTAT SETTING IN WINTER (average):
Number Used in Winter	Day Night None
CCUPANTS COMMENTS (e.g., drafty, cold floors, too expensive to heat, etc.):	# AMOUNT OF FUEL USED LAST HEATING SEASON: Primary Supplementary
	Туре
	Quantity
	Total Cost <u>\$</u>
	# DISTRICT HEATING FACTOR(from Manual, page 8)
	PAGE 1A

On pages 2 thru 7, separate parts of t page, and in the Su	he building	, and enter the resu	iltration and by Condu ilts in the table at i	uction thru the the bottom of each
Volume of Air in building Floor Area	HOUSE DRAF	HEAT LOS	S BY INFILTRATION action of the four complete condition of the land the land condition of the land condition o	onent parts of a build- circle adjacent to the building.
sq.ft.	COMPONENT	ONE Air Change Per Hour	TWO Air Change Per Hour	THREE Air Change Rer Hour
×	Or CRAWL SPACE	Tight, no cracks, caulked sills, sealed cellar windows, no grade entrance leaks Plywood floor, no trap door leaks, no leaks around water, sewer and electrical openings	Some foundation cracks, no weather stripping on cellar windows, grade entrance not tight Tongue and groove board floor, reasonable fit on trap doors, around pipes, etc.	Stone foundation. considerable leakage area. poor seal around grade entrance Board floor, loose fit around pipes, etc.
ft.	WINDOWS DOORS	Storm windows with good fit O Good fit on Storm doors	Ro storm windows, good fit on regular windows Loose storm doors.	No storm windows, loose fit on regular windows No storm doors
ing (to upstairs ceiling in two-story house)	WALLS	Caulked windows and doors, building paper wsed under siding	Caulking in poor repair, building needs paint	No indication of building paper, evident cracks around door and window frame
	of these pro	ducts, divided by 4	THEATING X .02	mn by 1, the second ndex will be the sum Heating Units Now Required
Potential Savings by Red It should be possible to changes to one per hour) loss would be:	reduce the d	raft index for a buildir	ng to 1 (that is reduce the	e number of air infiltration
Volume (from above) Subtract the potential h	Draft	Fac	Heating stor	Potential Heating Units
TYPE OF HEAT LOSS	U	ATING POTENTIAL NITS HEATING QUIRED SAVINGS	PROPOSED CHANGES TO STRU	HEATING UNITS TO TURE BE SAVED
EDIC	,	PAGE 2		

Floor Exposure Factor	101	Value of Floor					1 1
Select the appropriate factor	from List	below all mat ecting floor j	erials in flo	or deck, inc ng from insid	luding car le surface	rpet but and work—	\$
Building on posts or pilla with no skirts below floor	rs 1.0 inser	rt 'R' value f	or each compo	nent from Tab	le I		
Crawl space skirted	0.8	Material	Thickness	s. 'R' Value	٠.		
Rock wall*basement	0.8 Inte	rior Surface	1	.68	·	•	72
More than two feet of base-				.00	-		ळ
ment wall exposed above grade	0,8	Masag				• •	905
Building on stab	0.5					ŧ *	
Building with tight crawl	0.5				·		IN AT
Building with tight base—	-	<u> </u>					Z
ment (heated or unheated)	0.5		<u> </u>		•		-{
	intel	rior Surface,		.68			ノ こ
sq.ft. X	X			:	_=		7
Floor Area (from Build-		District	7 <u>@</u>	Total		Heating Uni	ts.
ing Descrip— Expos		Heating Factor		'R' Value	•	Required	
					-	-3 / ,	
Potential Savings on Floor Heat			•		•		
Floors can sometimes be insulated are below the floor may cause from drafts.	eezina problem	S CUTING VARV	"COID EDOILE	However			
protected from drafts, etc., so this building, the heat loss thr	THOT IT DOS D	tioor exposure	factor of 0.	5. With this	exposur	e factor for	
							•
sq.ft.X O.	5 X		1 - 1				1
Floor Area Floo		District	1 •	'R' Value		Determine	J.
From Above Expos	ure	Heating Factor		from Above		Potential Heating Units	
		1.5	•				1
ubtract the potential heating u	nits from those	now required	and Enter H	ere	-		
	•					Potential Heating	
	•		•			Savings	•
	•		←	· .			
	HEATING	POTENTIAL		•		HEATING	
TYPE OF HEAT LOSS	UNITS ر REQUIRED	HEATING SAVINGS	PROPOSED CI	IANGES TO STR	UCTURE	UNITS TO BE SAVED	
CONDUCTION THRU: FLOORS							
			•		<i>• • • • • • • • • •</i>		

PAGE-3

	HEAT LOSSES BY CONDUCTION THROUGH CEILINGS	
rea of Celling.		
Take area of upstains elling in a two-story ouse)		
etling area will ormally be the same		
i Gloor area (from Diding description	Material Thickness 'R' Value Inside Surface	
	00 C	
		Distance between joists/rafters:
		Juiscs/rarters:
• • • • • • • • • • • • • • • • • • •	Inside Surface (68)	
	OR Outside Surface (.17)	
		• • • • • • • • • • • • • • • • • • •
sq.ft. 🗙	+	= 1
Ceiling Area	District Total Heating Factor Privalue	Heating Units Required
tential Şayings by Insulation	of Ceilings	
well insulated ceiling (with ilding, the ceiling heat loss	6 inches of insulation) should have an 'R' valu	e of 20. If this was so for this
sq.ft. 🗶	÷ 20	=
Ceiling Area	District 'R' Value Heating Factor	Potential Heating Units
tract the potential heating t	units from those now required and Enter Here.	
		Potential Heating Savings
TYPE OF HEAT LOSS	HEATING POTENTIAL UNITS HEATING REQUIRED SAVINGS PROPOSED CHANGES	HEATING UNITS TO BE SAVED
TYPE OF HEAT LOSS DUCTION THRU: CEILINGS	UNITS HEATING -	UNITS TO



HEAT LOSSES BY CONDUCTION THROUGH DOUBLE GLASS OR PLASTIC COVERED WINDOWS AND THROUGH DOORS

(Assuming R = 2 for these units)

Area of Double Glass and Doors

Width °	x Height :	Number :	Area
		<u>, </u>	4
			.,
		_	
•		*.	
		·	
	N. Committee	1, 1	
	:	TOTAL	

District Heating Factor

'R' Value

Heating Units Required

Potential Savings

Triple glazing of windows can be done but is not usually practical. If no change is made in the windows, the Potential Saving will be 0 heating units and should be entered here

(If windows are triple glazed, the "R" value will be approx. 3 and the Potential Savings will be one-third of the "Heating Units Required.").

Potential Heating Savings

TYPE OF HEAT LOSS

HEATING & UNITS REQUIRED POTENTIAL HEATING SAVINGS

PROPOSED CHANGES TO STRUCTURE

HEATING UNITS TO BE SAVED.

SONDUCTION THRU: DOORS & DOUBLE-GLASS WINDOWS

PAGE 6

ERIC

Total Perimeter of Outside Wall	'R' Value of Outside Walls							
	including a	all materials in walls ir spaces within the v ent from Table 1.	s, starting from i wall. insert 'R'	hside and . value for .				
Tofal Height	Mate	erial Thickness	'R' Value	70				
of Outside Wall	ft. Inside sur	ace	.68	. 0				
\ <u>=</u>				 				
Gross Wall Area	sq.ft.			ς 2				
Total Area of al. Windows and Doors	sq.ft.							
(from previous two pages)	Outside surf	ace	17) **				
Net Wall Area	sq.ft. X	÷	=					
	District	Heating to	Total 'R' Value	Heating Units Required				
Patential Savings by Insulation								
We'll insulated walls should have loss would be:	an 'R' value of 15.	If this was so for	this building, th	e walf heat				
loss would be.								
	×	 	15 =					
Net Wall Area. (from box above)	District		'R' Value He	Potential eating Units				
Subtract the potential heating un	ite from those now	required and Enter H	lere [
	1		L.	otential				
				Heating Savings				
		<i>‡</i>	Art Services					
	.		•					
		Salar Salar						
HEAT UNI	ING POTENTIAL TS HEATING			HEATING UNITS TO				
TYPE OF HEAT LOSS REQU	IRED SAVINGS	PROPOSED CHANGES T	O STRUCTURE +	BE SAVED				
CONDUCTION THRU: WALLS			*					
ERIC	Page 7	166		••				

- 3 Use the instructions on page 11 of the FEA Winterization Manual to assess which potential savings can be obtained most successfully.
- Fill out the following Summary Table by entering the "Heating Units Required" and the "Potential Heating Savings" from the corresponding tables at the bottom of pages through 7. Then, write in the "Proposed Changes" and "Heating Units to be Saved" by such changes.

HEAT REQUI	REMENT ESTIM	ATES (Annual	Heating Units Needed)	
TYPE OF HEAT/LOSS	HEATING UNITS REQUIRED	POTENTIAL HEATING SAVINGS	PROPOSED CHANGES TO STRUCTURE	HEATING UNITS TO BE SAVED
INFILTRATION From Page 2				
CONDUCTION THRU: FLOORS Page 3	- 0			2,
CONDUCTION THRU: CEILINGS Page 4			Ģ	
CONDUCTION THRU: SINGLE-GLASS WINDOWS Page 5	5			
CONDUCTION THRU: DOORS & DOUBLE-GLASS WINDOWS Page 6				
CONDUCTION THRU: WALLS Page 7				

(5) Use the space below to calculate the quantities and cost of materials needed to make the proposed changes to the building.



Fill in job sheet on opposite page.

- JOB SHEET A

THIS PAGE IS REMOVABLE FOR USE AT JOB SITE

	* * .					
Name		 		•	•	
Address						_
ACCLESS.		 	 			

- <u></u>	Type of Materials	Quantity Required	Estimated Cost	Location Where Materials Are To Be Installed (Walls; Ceiling, etc.)	Installation Diagram No.	Special Instructions
-						
•						
	-		3			
		(INS	ERT CARBO	N PAPER UNDER TABLE AT TOP OF PA	GE ONLY)	

Map or directions for locating home:

Activity. Order Materials Install Materials

Estimated Location Where Materials Are To Be Installation Type of Quantity Special .Materials Required Cost Installed (Walls, Ceiling, Etc.) Diagram No. -Instructions Total Cost PAY-OFF TIME This is the number of seasons for fuel savings to pay off the cost of winterization. Total Cost (from job sheet-above)

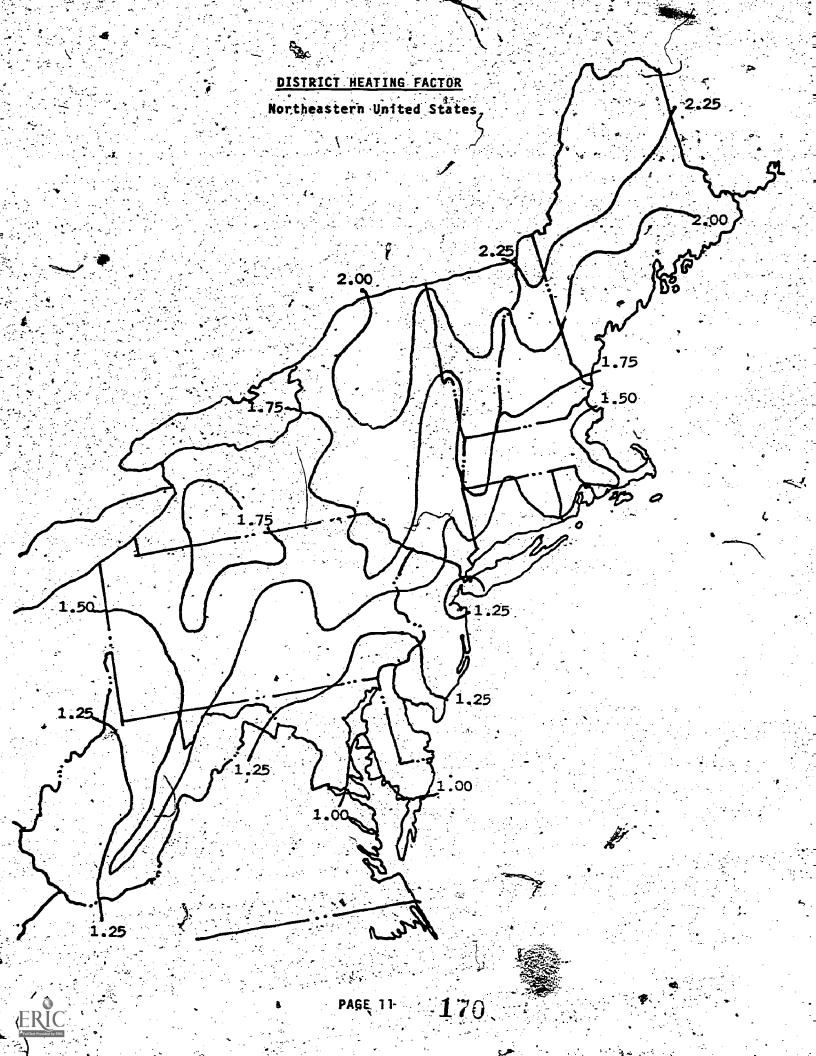
Fuel Factor
Fuel Oil = 1
Natural Gas = 120
Electricity = 30

y Total ... Heating Units ... Saved (From page 8)

Price of Fuel Per gal, cu.ft.,KWH "Pay-off" Time (seasons)

ERIC

PAGE 10. 169



INSULATION VALUE OF COMMON MATERIALS

Source: ASHRAE Guide and Data Book

MATERIAL	THICKNESS	R VALUE
Air Film and Spaces:		
Air space, bounded by ordinary materi Air Space, bounded by aluminum foil	als 3/4" or more 3/4" or more	0.91 2.17
Exterior surface resistance Interior surface resistance Masonry		0.17 0.68
Sand and gravel concrete block Sand and gravel concrete block Lightweight concrete block	8" 12" 8"	1.11 1.28 2.00
Lightweight concrete block Face brick Concrete cast≈in place	12" 4" 8"	2.13 0.44 0.64
Building Materials - General		
Wood sheathing or subfloor Fiber board insulating sheathing Plywood	3/4" - .3/4" 5/8"	1.00 2.10 0.79
Plywood Plywood Bevel lapped siding	1/2" 3/8" 1/2" x 8"	0.63 0.47~ .0.81
Bevel lapped siding Vertical tongue and groove board Drop siding	3/4" x 10" 3/4" 3/4"	1.05 1.00 0.94
Asbestos board 3/8" gypsum lath and 3/8" plaster Gypsum board	1/4" 3/4" 3/8"	0.13 0.42 0.32
Interior plymod panel Building paper Vapor barrier	1/4" 	0.31 0.06 0.00
Wood shingles Asphalt shingles		0.87 0.44 0.08
Carpet with fiber pad Hardwood floor		2.08 - 0.71
Insulation Materials (mineral wool, glass)	wool, wood wool, etc.)	
Blanket or batts Blanket or batts Blanket or batts	3 1/2" 6"	3.70 11.00 19.00
Loose fill Rigid insulation board (sheathing)	3/4"	3.33 2.10
Windows and Doors		.
Single window Double window Exterior door	App	rox. 1.00 rox. 2.00 rox. 2.00